

THE ICHNEUMONID PARASITES ASSOCIATED WITH THE
GYPSY MOTH (*LYMANTRIA DISPAR*)

By

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THE ICHNEUMONID PARASITES ASSOCIATED WITH THE GYPSY MOTH (*LYMANTRIA DISPAR*)

INTRODUCTION

The gypsy moth, *Lymantria dispar*, is an important defoliator of hardwood trees, especially oaks, over much of Eurasia and Eastern North America. Although the moth caterpillars prefer the oaks, they feed on the leaves of over 500 plant species (Forbush and Fernald, 1896, Mosher, 1915). Their enormous feeding activity in seasons of outbreaks defoliate many important ornamental trees of great aesthetic value, such as the oaks, birch, poplars, willows, maple, elms, etc. Repeated defoliations reduce the vigor of the trees and secondary infestations by insects and diseases often kill the trees. The conifers, which are also attacked, are more susceptible to defoliation, and one complete defoliation by the gypsy moth may be fatal to the trees.

Ever since the escape of the gypsy moth into the forests of the New England states before the turn of the century, intensive and extensive work has been done in the United States to contain the pest and eradicate it. However, the efforts have not been successful and the pest has continued to spread. During the past eighty years or so, the pest has spread to most of the northeastern states, extending westwards to Pennsylvania and southwards to Maryland. The pest has also spread to certain pockets in Ohio, North and South Carolina, Virginia, West Virginia, Michigan, Wisconsin, Washington and Oregon.

Since 1905, millions of parasites of various species have been imported into the United States from Europe and Japan to control the gypsy moth. Only ten of them got established, including only one ichneumonid, *Phobocampe uncinata*. They have apparently not been very effective in checking the spread of the moth. Two of them, *Anastatus disparis* and *Ooencyrtus kuvanae* are egg parasites; two, *Apanteles melanoscelus* and *Phobocampe uncinata* (= *disparis*), parasitize smaller larvae (first to third instars); four, *Blepharipa pratensis*, *Compsilura concinnata*, *Exorista larvarum*, and *Parasetigena silvestris* attack mature larvae; and two, *Monodontomerus aereus* and *Brachymeria intermedia* are pupal parasites. Hoy (1976) has given a list of all the species imported by then and possible reasons for their non-establishment.

In Eurasia, the original home of the gypsy moth, there appears to be some sort of a natural balance between the moth and its parasites. Yet periodical outbreaks do occur in limited areas. It appears that the aggregate effect of the introduced natural enemies and the indigenous parasites of the gypsy moth in North America is approaching that which exists in Central Europe. In many New England localities infested with the gypsy moth, the natural enemies have been important factors in preventing outbreaks, or at least responsible for prolonging the intervals between the outbreaks.

The importance of the native ichneumonid parasites has also been underestimated. The success of a parasite has often been measured in terms of the

number of offspring a parasite is able to produce on the gypsy moth larvae or pupae, rather than upon the damage and "killings" a parasite accomplishes during the process of oviposition. A case in point is the work of Campbell (1963), on the four native ichneumonid parasites of the gypsy moth: *Itoplectis conquisitor*, *Coccygomimus pedalis*, *Theronia atalantae fulvescens* and *T. hilaris* in Glenville, New York State. They attack the gypsy moth pupae. They stung as many as 250 host pupae for each pupa that was parasitized successfully (leading to the development of an ichneumonid offspring). He further showed that the puncture wounds made by the ichneumonids while stinging the moth pupae, permitted the entrance of the larvae of the Sarcophagidae (which could enter the host pupae only when the integument was broken), eventually killing the host pupa. About half of the stung pupae contained the sarcophagid maggots.

By such an ichneumonid-sarcophagid relationship, and also by the mechanical injury caused to the gypsy moth pupae by stinging, many of them fail to produce adult moths. The ichneumonids, therefore, play a greater role in controlling the gypsy moth than that is generally assigned to them.

In recent years there has been a renewed activity to survey the natural enemies of the gypsy moth in different parts of the world and to introduce the promising species in the United States. Information on such activities is available in the reports of Drea (1978) in Europe, Iran and Japan; Drea and Fuester (1979) in Poland; Györfi (1963) in Hungary; Hedlund and Mihalache (1980) in Rumania; Herard and Fraval (1980) in Morocco; Herard, Mercadier and Abai (1979) in Iran; Pschorn-Walcher (1974) in Europe; Rao (1966, 1972) in India; Romanyk (1965) in Spain; Shapiro (1956) in Russia; and Vasic (1958) in Bulgaria. In a recent publication on the gypsy moth (Doane and McManus, editors, 1981), Dr. Coulson has reviewed the introductions of the parasites in the U.S.A. for the control of the gypsy moth.

In the United States, the states of New Jersey and Pennsylvania have recently been active in the release of exotic parasites. According to the publications of the Pennsylvania Bureau of Forestry, four species of *Coccygomimus* were released in Pennsylvania during 1973-79, as follows.

<i>Coccygomimus disparis</i> ,	73,215 ex stocks from India and Japan.
<i>C. instigator</i>	3,250 from Yugoslavia
<i>C. turionellae</i>	34,134 from India
<i>C. moraguesi</i>	5,600 from Morocco

Of these only two specimens of *C. disparis* were recovered in July 1981 (Dr. Fusco, personal correspondence), which appears significant because releases were made in 1979 or possibly in 1980, but not in 1981.

Phobocampe uncinata, which was established during 1911-1912 in the New England states has also spread to New Jersey and Pennsylvania and it appears that parasitism by this species is also increasing gradually in Pennsylvania since 1970, particularly in post-climax gypsy moth populations. The native pupal parasites were also active there in killing the host pupae.

The Ichneumonidae are either larval or pupal parasites of the gypsy moth. The typical larval parasites are the members of the genera *Phobocampe*, *Casinarina* and *Hyposoter*, belonging to the subfamily Porizontinae. They lay their eggs within the young gypsy moth larvae and emerge from older larvae and spin their own cocoons. Other internal parasites or endoparasites of the larvae are the members of the subfamily Banchinae, Cremastinae and Ophioninae. Members of the subfamily Anomalinae are endoparasites of the

larvae, but the emergence is from the host pupa. The external parasites of the larvae or ectoparasites are the members of the subfamily Tryphoninae. Members of the tribe Pimplini are external parasites of late larvae that have just spun their cocoons or the prepupae and the development is upon host larva within the cocoon. The Mesosteninae are apparently similar to the Pimplini in their host relations.

Members of the tribe Gelini and of subfamily Mesochorinae are secondary parasites of the various gypsy moth parasites, including Braconidae and Ichneumonidae. Some genera are parasitic upon Tachinidae, particularly the genera *Mesoleptus* and *Phygadeuon*. Species of *Itopectis* and *Theronia* are also hyperparasitic upon occasions.

The typical pupal parasites belong to the subfamily Ichneumoninae and the tribes Ephialtini and Theroniini of the subfamily Pimplinae, e.g., the genera *Coccygomimus*, *Itopectis*, *Ephialtes*, and *Theronia*. They are internal parasites of exposed or semiexposed pupae. Oviposition is into the prepupa or freshly formed pupa and the emergence of the adult parasite is from the host pupa.

MATERIAL AND METHODS

The purpose of the present study was to establish the identities of the various ichneumonid species that have been reported as parasites of the gypsy moth. Over a hundred species of the Ichneumonidae have been recorded as primary parasites and nearly 25 as secondary parasites. A near complete list of the species and the various taxonomic combinations under which they have been reported previously is given by Griffiths (1976). Previous useful compilations are of Howard and Fiske (1911), Stadler (1933), Schedl (1936) and Thompson (1946).

A literature search was made to establish the first records for each species from the gypsy moth. This revealed that several erroneous records had crept in the literature in the process of compilations. Many records have never been confirmed by subsequent rearings and in such cases it was difficult to assess the role of the parasite in the economy of the gypsy moth.

Attempts were made to gather specimens of Ichneumonidae that have been reared in the past. Unfortunately voucher specimens do not exist for most of the earlier records. The only source from which such material could be obtained was the Forest Insect Laboratory, Hamden, Connecticut, wherefrom specimens received and reared prior to 1930 were available.

In recent years several surveys have been made in Europe, Japan, India, Iran and Morocco, to gather insect parasites of the gypsy moth, and to introduce the promising species in the United States. Only a dozen or so species of Ichneumonidae have usually been reared belonging to the subfamilies Pimplinae and Porizontinae and one to the Ichneumoninae. Fortunately many of these specimens were available for study. This helped tremendously to establish the true identities of the species that are commonly encountered on the gypsy moth.

On the basis of these studies, 24 species of Ichneumonidae are confirmed as parasites of the gypsy moth in the world (List I), 31 species are shown definitely not to be associated with the gypsy moth (List III), and 38 species are listed as unconfirmed records from the gypsy moth (List II). Some of these may be occasional parasites, while some others appear to be misdeterminations. Two new species or subspecies are described: *Phobocampe lymantriaae* from *Lymantria dispar* in Europe and Japan, and *Theronia atalantae himalay-*

ensis from *Lymantria obfuscata* from India. The taxonomic identity of all the species has been updated.

The hyperparasites are listed in List IV. The hyperparasites were not studied. Ichneumonid parasites reared in India from *Lymantria obfuscata*, a related species, are mentioned in List V. Many of these are being reared in the U.S.A. for possible releases against the gypsy moth.

The institutions that loaned the species for the present study are listed below, along with the names of the persons who arranged for the loans.

Bangalore, India	Commonwealth Institute of Biological Control, Indian Station, P.O. Box 2484, Bangalore, 560 024, India. (T. Sankaran).
Newark, DE	Beneficial Insects Research Laboratory, 501 S. Chapel St., Newark, Delaware, 19713. (L. R. Ertle, R. W. Fuester, R. J. Dysart, P. W. Schaefer).
Middletown, PA	Division of Forest Pest Management, Bureau of Forestry, 34 Airport Drive, Middletown, Pa. 17057. (R. A. Fusco).
Washington, D.C.	National Museum of Natural History, Smithsonian Institution, Washington, D. C. 20560. (A. S. Menke).
Trenton, NJ	N.J. Dept. of Agriculture, Beneficial Insects Laboratory, 101 Oakland St., Trenton, NJ 08618. (R. Chianese).
EPL - Paris	European Parasite Laboratory, USDA, c/o American Embassy, AGR APO New York, NY 09777. (B. D. Perkins).
Hamden, CT	Forest Insect and Disease Laboratory, Forest Service, USDA, 51 Mill Pond Road, Hamden, CT 06514 (W. E. Wallner).

In the lists and the text, that follows, the arrangement of the subfamilies is in the order of their importance, and not taxonomic. Most species are parasitic on several other lepidopterous pests besides the gypsy moth. The list of alternative hosts is by no means complete. Thompson (1957), Aubert (1967, 75), Townes et al. (1965) and Krombein et al. (1979) provide information on the hosts of the various species of the Ichneumonidae. The nomenclature of the lepidopterous pests has been updated after Lerut (1980).

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I record my appreciation and thanks to Mr. L. E. Ling, who took the SEM photographs for me.

LIST I

Ichneumonid species that are parasitic upon the gypsy moth and which have been commonly reared from the pest. Specimens of these species have been examined, reared from the gypsy moth.

SUBFAMILY PIMPLINAE

1. *Coccygomimus instigator* (Fabricius) Page 23.
Pupal parasite in Eurasia, Iran and Morocco. Released in the U.S.A. during 1906-1909 and again in 1972-79, but not established.
2. *Coccygomimus pedalis* (Cresson) Page 25.
Native North American parasite, stinging and killing a number of host pupae, without successfully parasitizing them.
3. *Coccygomimus turionellae* (Linnaeus) Page 26.
(= *Pimpla examinador* Fabricius).
Pupal parasite, reared in Eurasia and India. Released several times in the U.S.A., but not established.
4. *Coccygomimus moraguesi* (Schmiedeknecht) Page 28.
(= *C. turionellae moraguesi*)
Apparently first reared from the gypsy moth pupae by Herard and Fravel (1980) during 1973-75 in Morocco. Also occurring in Algeria and Spain. Cultured and released in Pennsylvania during 1973-79 but not established.
5. *Coccygomimus disparis* (Viereck) Page 29.
(= *Pimpla porthetriae* Vier.)
A Japanese parasite of the gypsy moth, subsequently collected in India, China, Mongolia and USSR. Released in Pennsylvania during 1973-79, bred from stocks from India and Japan. Recently recovered there.
6. *Coccygomimus luctuosus* (Smith) Page 31.
(= misdetermination of *Pimpla pluto* and *porthetriae* in gypsy moth literature).
A pupal parasite of the gypsy moth. Distributed in Japan and eastern Asia.
7. *Itoplectis conquisitor* (Say) Page 35.
Native North American pupal parasite, stinging and killing a large number of host pupae without successfully parasitizing them.
8. *Itoplectis alternans alternans* (Gravenhorst) Page 36.
9. *Itoplectis maculator maculator* (Fabricius) Page 37.
10. *Itoplectis clavicornis* (Thomson) Page 38.
Specimens of the first two species have been examined, labelled as reared from the gypsy moth and also from its parasite *Phobocampe uncinata*. The third species is labelled as reared from *Phobocampe uncinata* only. They occur in Europe. *I. alternans spectabilis* occurs in Japan and is reported parasitic on the gypsy moth.
11. *Ephialtes capulifera* (Kriechbaumer) Page 41.
12. *Ephialtes compunctor* (Linnaeus) Page 42.
(= *Pimpla brassicae* Poda)
Reared specimens of the above two species have been examined from Europe and Japan. Vasic (1958) and Hedlund and Mihalache (1980) reported having reared the latter species in Yugoslavia and Rumania, respectively.

13. *Theronia atalantae atalantae* (Poda) Page 45.
14. *T. atalantae gestator* (Thunberg) Page 48.
15. *T. atalantae fulvescens* (Cresson) Page 46.
Various subspecies of *Theronia atalantae* parasitize pupae of the gypsy moth in Europe, Japan and North America. A related subspecies, *himalayensis*, is described here as new from *Lymantria obfuscata* in India. Sometimes *T. atalantae* is hyperparasitic.
16. *Iseropus (Gregopimpla) himalayensis* Page 55.
A reared specimen from Japan has been examined.

SUBFAMILY PORIZONTINAE

17. *Casinaria tenuiventris* (Gravenhorst) Page 63.
(= *Campoplex conicus* Ratzeburg)
Reared several times in Europe from the gypsy moth and also in Iran in 1976. It has apparently not been seriously considered for introduction in the U.S.A.
18. *Casinaria nigripes* (Gravenhorst) Page 64.
(= *Casinaria anastomosis* Uchida)
This species occurs in Europe and Japan and has been reared in small numbers only.
19. *Campoletis* sp. Page 66.
Two reared specimens from France seen but the specific identity is uncertain.
20. *Phobocampe uncinata* (Gravenhorst) Page 68.
(= *Hyposoter disparis* Viereck = *Phobocampe* sp. of Herard *et al.* from Iran).
A widespread species in Eurasia and already established in the U.S.A.
21. *Phobocampe lymantriae* Gupta Page 73.
(= *Phobocampe* n. sp. of Drea and Fuester, 1979, from Poland)
(= *Hyposoter* spp of Burgess and Crossman, 1929).
A species sympatric and similar to *uncinata*, but biologically rather different. Occurs in Europe and Japan. The majority of the specimens mentioned under "*Hyposoter* spp." by Burgess and Crossman belongs to this species.
22. *Hyposoter vierecki* T. M. & T. Page 77.
(= *Campoplex (Diadegma) japonicus* Viereck)
Japan. Rearing records are rather few.
23. *Hyposoter tricoloripes* (Viereck) Page 78.
Reared several times in Europe in small numbers and apparently released in North America, without success.
A related species, *H. lymantriae* occurs in India on *Lymantria obfuscata*. This has been recently reared in large numbers at BIRL, Delaware on the gypsy moth for possible release in the U.S.A.

SUBFAMILY ICHNEUMONINAE

24. *Lymantrichneumon disparis* (Poda) Pages 81, 87.
(= *Ichneumon flavatorius* = *Trogus flavatorius*).
A common but not abundant pupal parasite of the gypsy moth in Europe. Also reported from Iran by Herard *et al.* (1979). Never reared in

large numbers for release in the U.S.A.

List II

Ichneumonid parasites that have been reported from the gypsy moth, but the records of which could not be confirmed by examination of the reared material. Some of them may be occasional parasites. The taxonomic identity of quite a few species is doubtful.

SUBFAMILY PIMPLINAE

1. *Coccygomimus spurius* (Gravenhorst) Page 32.
Yafaeva (1959) recorded it from Ukraine. Aubert (1969) and Kasparyan (1974) did not list it as a gypsy moth parasite.
2. "*Coccygomimus* sp." of Picard (1921) from France and of Herard and Fraval (1980) from Morocco can be any one of the known species of *Coccygomimus*. Identity doubtful.
3. *Itoplectis alternans spectabilis* (Matsumura) Page 37.
Reported by Fukaya (1936) from Japan. No subsequent confirmation.
4. *Itoplectis viduata* (Gravenhorst) Page 39.
Reported by Meyer (1929) from Russia.
5. *Ephialtes rufatus* (Gmelin) Page 43.
(= *rufata* Gravenhorst)
Reported by Rudow (1911) and Meyer (1927) from Germany and Russia respectively. Not listed subsequently by Meyer (1934, 1936).
6. *Theronia hilaris hilaris* (Say) Page 50.
(= *T. melanocephala*). North America.
Earlier records of this species were considered to be misidentifications of *Theronia atalantae fulvescens*. Campbell (1963) mentioned having observed this species also on the gypsy moth, but did not discuss it further. It may be an occasional parasite of the gypsy moth.
7. *Acropimpla didyma* (Gravenhorst) Page 51.
Šedivý (1963) mentioned it from Czechoslovakia as *Ephialtes didymus*.
8. *Iseropus (I.) stercorator stercorator* (Fabricius) Page 53.
(= *Pimpla holmgreni*)
Rudow (1911) reported it from Europe from *Lymantria dispar* and *L. monacha*, but in 1917 listed only *L. monacha* as its host. There are several such cases and his 1911 records appear rather doubtful.
9. *Iseropus (Gregopimpla) inquisitor* (Scopoli) Page 54.
Stadler (1933) apparently is the first to list it as a gypsy moth parasite in Europe. Vasic (1958) reported it from Yugoslavia. No specimens, however, could be examined to confirm its occurrence on the gypsy moth. It may be an occasional parasite or a hyperparasite associated with the gypsy moth.

SUBFAMILY PORIZONTINAE

10. *Campoplex difformis* (Gmelin) Page 60.
(= ?*Campoplex difformis* Gravenhorst)
Species of *Campoplex* have often been misidentified in Europe and it is doubtful what species, if any, is associated with the gypsy moth.
11. *Campoplex sugiharai* (Uchida) Page 61.
Momi (1961) reported it from Japan as a parasite of the gypsy moth.
12. *Phobocampe pulchella* Thomson Page 67.
Shapiro (1956) reported it from Russia. Drea (in Doane and McManus, 1981: 317) mentioned it from Yugoslavia (determination by Vasic).
Apparently a misdetermination of either *P. uncinata* or *P. lymantriae*.
13. *Hyposoter takagii* (Matsumura) Page 76.
Fukaya (1950) first reported it from Japan. There are no subsequent confirmations.

SUBFAMILY ICHNEUMONINAE

Almost all Ichneumoninae except *Lymantrichneumon disparis* (Poda) have not been reared from the gypsy moth subsequent to their original records. They have been merely catalogued subsequently, chiefly by Schedl (1936) and Thompson (1946). Those cataloguers, however, missed several species recorded from the gypsy moth by Rudow (1917, 1918).

Györfi (1963) mentioned *Protichneumon rubens* and *P. fabricator*, from the gypsy moth, but the authenticity of these records cannot be confirmed. Herard and Fraival (1980) mentioned having reared a species of *Melanichneumon* (= *Vulgichneumon*) from Morocco. In the list that follows, the names used in gypsy moth literature are given together with the original records. Taxonomic details are given in the text.

14. *Paracoelichneumon rubens* (Fonscolombe) Page 88.
(= *Ichneumon* = *Protichneumon* = '*Ichneumon rubens* Wesm.')
Rudow (1918). Europe.
15. *Callajoppa cirrogaster cirrogaster* (Schrank) Page 89.
(= *Ichneumon lutorius* F. = *Trogus flavitorius lutorius* F. = *Trogus lutorius* F.) Howard and Fiske (1911). Europe.
16. *Ichneumon cyaniventris* Wesmael Page 91.
Rudow (1918). Europe.
17. *Stenaoplus pictus* (Gravenhorst) Page 94.
(= "*Ichneumon pictus* Gmelin" of Stadler, Schedl and Thompson
= *Stenichneumon pictus* Gmelin of Thompson)
Mocsary (1885). Berthoumieu (1895). Europe.
18. *Melanichneumon leucocheilus* (Wesmael) Page 95. Europe.
(= *Ichneumon leucocheilus* of Rudow, 1918 = '*Ichneumon leucocherrus*'
of Stadler and Schedl, 1936, and *I. leucocerus* of Thompson, 1946).
= ?*Melanichneumon* (*Vulgichneumon*) sp. of Herard and Fraival, 1980
from Morocco?
19. *Cratichneumon fabricator* (Fabricius) Page 96.
(= *Ichneumon* = *Protichneumon*)
Cecconi (1924), Györfi (1963). Europe.

20. *Chasmias paludator* (Desvignes) Page 97.
 (= *Ichneumon* = *Chasmodes paludicola*)
 Rudow (1917). Europe.
21. *Pterocormus sarcitorius sarcitorius* (Linnaeus) Page 98.
 (= *Ichneumon sarcitorius*)
 Meyer (1929). Russia.
22. *Triptognathus amatorius* (Mueller) Page 99.
 (= *Ichneumon* = *Amblyteles* = *Diphyus*)
 Rudow (1917), Uchida (1926). Japan, Sakhalin.
23. *Spilichneumon occisor* (Fabricius) Page 100.
 (= *Ichneumon* = *Amblyteles*)
 Rudow (1917). Europe.
24. *Amblyteles armatorius* (Förster) Page 102.
 (= *Amblyteles fasciatorius*)
 Uchida (1930). Japan.
25. *Cotiheresiarches dirus* (Wesmael) Page 104.
 (= *Eurylabus dirus*)
 Fahringer (1922). Europe.

SUBFAMILY MESOSTENINAE

26. *Gambrus amoenus* (Gravenhorst) Page 106.
 (= *Cryptus*, *Aritranis*, *Spilocryptus*)
 = *Gambrus nuncius* (Say). N. America. N. syn.
 Howard and Fiske (1911). Europe.
27. *Meringopus cyanator* (Gravenhorst) Page 108.
 (= *Cryptus*, *Trachysphyrus*)
 Howard and Fiske (1911). Europe.
28. *Ischnus inquisitorius inquisitorius* (Mueller) Page 109.
 (= *Ichneumon assertorius* = *Ischnus assertorius*)
 Rudow, (1917). Europe.

SUBFAMILY TRYPHONINAE

29. *Netelia (Netelia) vinulae* (Scopoli) Page 111.
 (= *Panicus cephalotes*)
 Rühl (1914). Europe.
30. *Netelia (Netelia) sp.* Page 111.
 (= ?*Paniscus testaceus*)
 Rühl (1914). Europe.

SUBFAMILY BANCHINAE

31. *Banchus hastator* (Fabricius) Page 113.
 (= *Banchus femoralis*)
 Kolubajiv (1934). Europe.

SUBFAMILY CREMASTINAE

32. *Pristomerus vulnerator* (Panzer) Page 115.
Barsacq (1913), Mokrzecki (1913). Europe.

SUBFAMILY ANOMALINAE

33. *Trichomma* (*Trichomella*) *enecator* (Rossi) Page 118.
(= *Anomalon enecator*)
Kirchner (1856). Europe.
34. *Barylypa delictor* (Thunberg) Page 120.
(= *B. perspicillator*)
Kovacevic (1925). Europe.
35. *Barylypa pallida* (Gravenhorst) Page 120.
(= *Anomalon pallidum*)
Rudow (1911). Europe.
36. *Agrypon flaveolatum* (Gravenhorst) Page 120.
(= *Ophion*, *Anomalon*)
Rudow (1911). Europe.

SUBFAMILY OPHIONINAE

37. "*Ophion luteus* (Linnaeus)" Page 122.
Kolomiyetz (1958). Siberia. Identity of this species doubtful, as
O. luteus, has often been misidentified.
38. *Enicospilus merdarius* (Gravenhorst) Page 123.
(= *Ophion*)
Rühl (1914). Europe.

Several other species recently collected in Morocco, Iran, etc., chiefly by the staff of the European Parasite Laboratory, Paris, are mentioned in reports as Ichneumonid sp. A, B, C, D, etc. A recent letter from Dr. Lawrence R. Ertle (dated June 18, 1982), states, "The Ichneumonids as 'A', 'B', and 'C' were hyperparasites of *Apanteles liparidis* and *A. melanoscelus*; Ichneumonids 'D' and 'E' were not collected from *L. dispar* (L.), but from *Orgyia* sp."

LIST III

Ichneumonid species that are definitely not associated with the gypsy moth. Reasons for excluding them are given in details in the text.

SUBFAMILY PIMPLINAE

1. *Perithous septemcinctorius* (Thunberg) Page 16.
= *Hybomischos*. Parasitic upon Sphecidae rather than on Lepidoptera.
2. *Dolichomitus tuberculatus* (Fourcroy) Page 16.
Parasitic upon wood boring Coleoptera.

3. *Exeristes roborator* (Fabricius) Page 17.
(= *Iseropus roborator*)
Parasitic upon *Ostrinia* and related lepidopterous borers.
4. *Coccygomimus aethiops* (Curtis) Page 19.
Wrongly listed by Thompson (1946).
5. *Coccygomimus pluto* (Ashmead) Page 19.
Misdetermination of *luctuosus* Smith.
6. *Coccygomimus tenuicornis* (Cresson) Page 19.
Misdetermination of either *C. pedalis* or *Itoplectis conquisitor*.

SUBFAMILY PORIZONTINAE

7. *Sinophorus validus* (Cresson) Page 58.
Fusco and Simons (1977) listed it as a native gypsy moth parasite, but correspondence with them failed to confirm its occurrence on the gypsy moth. Not listed from the gypsy moth by Carlson (1979).
8. *Campoplex difformis* Gravenhorst Page 60.
Reported by Ratzeburg (1844). Its identity is uncertain and it was almost certainly a misdetermination.
9. "*Omorgus* sp." of Kolomietz (1958) Page 59.
Reported as a parasite of the pupa of the gypsy moth. Appears to be a misidentification.
10. *Casinaria ischnogaster* (Thomson) Page 62.
Morley and Rait-Smith erroneously reported it as a European parasite of the gypsy moth.
11. *Hyposoter fugitivus* (Say) Page 77.
(= *Limneria fugitiva*, *Limnerium* sp.)
Erroneous record (Howard and Fiske, 1911).
12. *Campoplex rapax* Gravenhorst Pages 59, 75.
(= *Anilastus* = *Anilasta*)
Recorded by Rudow (1911). Its identity is very doubtful.

SUBFAMILY SCOLOBATINAE

13. *Opheltes glaucopteros* (Linnaeus) Page 124.
Record of its occurrence on the gypsy moth, originating from Rühl (1914) is erroneous, as members of the genus *Opheltes* are parasitic upon *Cimbex* (saw-flies). Györfi (1963) mentioned it and several other doubtful species from Hungary.

SUBFAMILY XORIDINAE

14. *Xylonomus irrigator* (Fabricius) Page 124.
15. *Xorides praecatorius* (Fabricius) Page 124.
Rudow (1911) erroneously listed the above two species as gypsy moth parasites. They belong to *Xorides*, which are parasites of wood boring Coleopterous larvae. Morley (1908) also erroneously reported *Odontomerus dentipes* as a parasite of *Lymantria monacha*.

SUBFAMILY ICHNEUMONINAE

16. *Ichneumon raptorius* Gravenhorst Page 80.
17. *Ichneumon sugillatorius* Linnaeus Pages 80, 91.
18. *Ichneumon melanoceras* Ratzeburg Page 80.
 These species were mentioned by Rudow (1911) as parasites of both *Lymantria dispar* and *L. monacha*, but later (1918) only as parasites of *L. monacha*. Many such records of Rudow (1911) appear erroneous for the gypsy moth.
19. *Ichneumon* sp. Page 93.
 Picard, 1921. Identity uncertain.
20. *Ichneumon leucocerus* (Gravenhorst) Page 92.
 Thompson (1946). Misquotation of *Ichneumon leucocheilus* Wesmael.
21. "*Ichneumon leucocherrus*" Wesmael Page 92.
 Stadler (1933), Schedl (1936). *Lapsus* for *I. leucocheilus* Wesmael.
22. "*Ichneumon pictus* Gmelin" Page 92.
 Stadler (1933). Identity of this species doubtful.
23. "*Ichneumon flavus* Rd." Page 93.
 (= *Ischnus flavus* Rd. of Stadler, 1933)
 Rudow (1933) manuscript name. *Nomen nudum*.
24. "*Amblyteles varipes* Rudow" Page 103.
 Rudow (1888). Identity doubtful.
25. "*Amblyteles camelinus* Wesmael" Page 103.
 Meyer (1936). Not a gypsy moth parasite.

SUBFAMILY MESOSTENINAE

26. "*Ischnus flavus* Rd." Page 105.
 Stadler (1933). Europe.
Nomen nudum.
27. "*Cryptus liparidis* Rd." Page 105.
 Rudow (1918). Stadler (1933). *Nomen nudum*. Subsequent authors listed the author as "Rond."

SUBFAMILY GELINAE

28. *Mesoleptus laevigatus* (Gravenhorst)
 (= *Exolytus laevigatus*)
 Shapiro (1956). Russia.
 A parasite of Diptera (mostly on Sarcophagidae) and not of Lepidoptera.
 A related *M. filicornis* recorded erroneously on *L. monacha*.

SUBFAMILY TRYPHONINAE

29. "*Paniscus melanurus* Thomson" Pages 111, 112.
 Meyer (1936) apparently confused it with *testaceus*. Identity uncertain.
30. "*Paniscus testaceus* Gravenhorst" Pages 110, 111.
 What species was actually involved (Rühl, 1914) is doubtful as *testaceus* has been very often misidentified in the past. The true identity of it is unknown.

SUBFAMILY BANCHINAE

31. *Banchus falcatorius* (Fabricius) Page 114.

(= *Banchus falcator*)

Morley (1915). Data as recorded by Morley indicate that it was never reared from the gypsy moth, but collected flying where gypsy moth larvae were also present.

LIST IV

Ichneumonid hyperparasites associated with the gypsy moth

SUBFAMILY MESOCHORINAE

Several species of *Mesochorus*, parasitic upon *Apanteles* species have been associated with the gypsy moth, chiefly in Europe.

1. *Mesochorus ater* Ratzeburg. Europe.
2. *M. confusus* Holmgren. Europe, N. Africa.
3. *M. discitergus* (Say).
(= *facialis* Bridgman). Holarctic, Oriental.
4. *M. dilutus* Ratzeburg. Europe.
5. *M. dorsalis* Holmgren. Europe.
6. *M. gracilis* Brischke. Europe.
7. *M. pallidus* Brischke. Europe.
8. *M. pectoralis* Ratzeburg. Europe.
9. *M. semirufus* Holmgren. Europe.
10. *M. splendidulus* Gravenhorst. Europe.
11. *M. sylvarum* Curtis. Europe.
12. *M. vitreus* Walsh. N. America.

SUBFAMILY GELINAE

1. *Acrolyta nigricapitata* (Cook & Davis). N. America.
2. *Atractodes croceicornis* Haliday (= *A. compressus* Thomson). Europe.
Parasite of Diptera. Might be secondary on Tachinidae associated with the gypsy moth.
3. *Bathythrix triangularis* (Cresson) (= *Thysiotorus*, *Mesoleptus*). North America.
- 3a. *Dichogaster aestivalis* Gravenhorst (= *Hemiteles aestivalis*). Incorrect record. Parasitic upon Chrysopidae and not associated with *Lymantria*.

Genus *Gelis*

(Many species reported under *Pezomachus* and some under *Hemiteles*.)

4. *G. agilis* Fabricius. Europe.
5. *G. apantelis* Cushman. U. S. A.
6. *G. areator* Panzer (= *Hemiteles areator*). Europe.

7. *G. cinctus* Linnaeus (= *Hemiteles bicolorinus* Grav.) Europe.
8. *G. cushmani* Carlson (= *Hemiteles apanteles* Cushman) U. S. A.
9. *G. hortensis* Gravenhorst (= *Pezomachus*) Europe.
10. *G. instabilis* Foerster (= *Pezomachus*) Europe.
11. *G. intermedius* Foerster. Europe.
12. *G. inutilis* Cushman. U. S. A.
13. *G. nigriceps* Foerster. Europe.
14. *G. nigratus* Foerster. Europe.
15. *G. nocuus* Cushman. U. S. A.
16. *G. obscurus* Cresson. U. S. A.
17. *G. pulchellus* Gravenhorst. Eurasia.
18. *G. pulicarius* Fabricius. Europe.
19. *G. tenellus* Say. U. S. A.
20. *G. urbanus* Brues (= *Hemiteles cingulator* Gravenhorst). Wrong record.
21. *Lysibia nana* Gravenhorst (= *Astomaspis nana*, *Hemiteles nanus*, *Hemiteles fulvipes* Grav.) Europe.
22. *Mesoleptus filicornis* Thomson (= *Exolytus*) Europe.
Parasitic on Tachinidae. May be on tachinid parasites of gypsy moth.
23. *Phygadeuon subfuscus* Cresson. U. S. A.
Parasitic on *Sturmia scutellata*.
Four other species of *Phygadeuon* have been reported in association with *Lymantria monacha*, viz., *P. flavimanus* Grav., *fumator* Grav., *grandiceps* Grav., and *variabilis* Gravenhorst. They are parasitic on Tachinidae, perhaps associated with the nun-moth.

Species of the Pimpline genera *Itoplectis* and *Theronia* are also occasionally hyperparasitic through other ichneumonids of the gypsy moth.

Euceros albomarginatus Cushman

Two males examined, bearing the following data:

"Eastern Pa., Summer 1976. Reared from *Phobocampe* cocoon from *L. dispar* (Pennsylvania Bur. Forestry)".

LIST V

Ichneumonid parasites associated with *Lymantria obfuscata* Walker

Lymantria obfuscata occurs in India and its habits are similar to those of *L. dispar*. The two were confused for a long time. Nagaraja *et al.* (1968) and Rao (1972) showed that the two were different species.

The following ichneumonid parasites occur on *Lymantria obfuscata* in India:

1. *Coccygomimus turionellae* (L.).
2. *C. disparis* (Viereck) (= *Pimpla* sp., *turionellae* Gr.)
3. *C. laothoë* (Cameron) (= *poesia*).
4. *Theronia atalantae himalayensis* Gupta (= *Theronia* sp., *T. atalantae atalantae*).
5. *Hyposoter lymantriae* Cushman (= *Anilastus* sp., *Hyposoter* sp.).

Some of the above species have been reared on the gypsy moth in the U.S.A. and also released in the field.

The identities of other ichneumonids reported by Rao (1966, 1972) have not been established. These are "Cryptinae gen. et sp. indet.", *Cryptus* sp., Metopiinae - Exochini "gen. et sp. indet." and *Goryphus* sp. nr. *inferus*.

KEY TO THE SUBFAMILIES OF ICHNEUMONIDAE ASSOCIATED WITH THE GYPSY MOTH

1. Wingless. Some GELINAE
 Winged. 2
2. Clypeus and face forming a broad, weakly convex surface. Clypeus not separated from face by a distinct groove. Areolet rhombic, large. First tergite with a large glymma, its spiracles near middle. Male claspers rod-like. Female subgenital plate large, triangular. Brownish species, hyperparasitic within braconid cocoons.
(Mesochorus). MESOCHORINAE
 Not as above. Clypeus separated from face by a distinct groove except in Porizontinae. Areolet various, never rhombic. 3
3. Spiracle of first tergite placed behind the midlength of the tergite. First tergite usually petiolate, slender at base. 4
 Spiracle of first tergite placed near midlength of the tergite. First tergite usually quadrate to narrowly trapezoid, not slender at base. 10
4. Abdomen compressed laterally. Third and fourth segments deeper than wide. 5
 Abdomen depressed or cylindric. Third and fourth segments wider than deep. 8
5. First intercubital vein (or the only intercubital vein present) joining cubitus vein distad of second recurrent vein by a distance greater than half its length. Epomia absent. Medium to large sized, pale brown colored slender species with very compressed abdomen. *(Ophion)*.
 IX. OPHIONINAE
 First intercubital vein joining cubitus basad of, opposite, or less than half its length distad of second recurrent vein. 6
6. Propodeum coarsely reticulated. Areolet absent. Hind tarsus often swollen, especially in males. Slender species with long and much compressed abdomen. VIII. ANOMALINAE
 Propodeum not reticulated, with distinct carinae bounding separated areas. Areolet present or absent. Hind tarsus not swollen. 7
7. Clypeus usually confluent with face. Face usually black. Ovipositor straight or decurved. Hind femur not toothed below.
 II. PORIZONTINAE
 Clypeus separated from face by a groove. Face usually pale. Ovipositor sinuate and hind femur toothed below in the genus associated with the gypsy moth. *(Pristomerus)*. VII. CREMASTINAE
8. Ovipositor very short, hardly surpassing the tip of abdomen, its sheaths always rigid. Notauli and sternaulus weak and short, or absent. Clypeus broader, with its apex flat and truncate.
 III. ICHNEUMONINAE

- Ovipositor long to short, conspicuously extending beyond the tip of abdomen. Notauli and sternaulus conspicuous. Ovipositor sheaths usually flexible. 9
9. Second recurrent vein with two bullae, sloping outwards. Propodeum usually fully areolated. Face of male usually black. Hyperparasites. GELINAE
- Second recurrent vein with a single bulla, not sloping outwards. Propodeum with only transverse carinae, usually the basal transverse carina alone prominent. IV. MESOSTENINAE
10. Tarsal claws not pectinate in females, sometimes with a large basal tooth on some claws. Abdomen depressed. I. PIMPLINAE
- Tarsal claws pectinate. Abdomen compressed. 11
11. Prepectal carina present. Upper tooth of mandible a sharp point. (*Netelia*). V. TRYPHONINAE
- Prepectal carina absent. Upper tooth of mandible obliquely chisel-shaped. (*Banchus*). VI. BANCHINAE

I. SUBFAMILY PIMPLINAE (= EPHIALTINAE)

Members of the subfamily Pimplinae are characterized by having a depressed abdomen, with first segment short, stout, broad, with its spiracle at or in front of the middle. Glymma nearly always present. Apical margin of clypeus usually thin and with a median notch. Mandible with two teeth. Notauli weak or absent. Sternaulus absent or short and weak. Postpectal carina incomplete. Propodeum usually not areolated (except *Xanthopimpla*, *Theronia* and related genera). Tarsal claws never pectinate. Areolet usually present and triangular. Nervellus intercepted variously. Abdominal tergites usually with paired swellings. Ovipositor long, its tip without any notch, the lower valve tip with ridges.

The larva of the Pimplinae differs from that of all other Ichneumonidae in having the hypostomal spur and the stipital sclerite both well developed and reaching each other at their apices, rather than the hypostomal spur reaching the stipital sclerite before its apex. The larval antenna is usually well developed and the mandible is with teeth, but in the tribe Ephialtini the antenna is vestigial and the mandible is without teeth (cf. figures 123-132).

The adults are rather large and slender, with body and ovipositor elongate. They are generally black in color (*Coccygomimus*, *Itopectis*, *Ephialtes*, etc.) or yellow to yellowish-brown (*Theronia*, *Xanthopimpla*).

Several species of Pimplinae are important parasites of the gypsy moth. They are discussed below. The following species were erroneously recorded as gypsy moth parasites, or their records are doubtful.

1. *Perithous semptemcinctorius* (Thunberg)

Griffiths (1976) reported this species as a parasite of *Lymantria dispar* from Bulgaria, quoting Stefanov and Keremidchiev (1961). This species belongs to the genus *Hybomischos*, the species of which are parasitic upon Sphecidae nesting in canes or twigs.

2. *Dolichomitus tuberculatus* (Fourcroy)

This species has often been recorded as a parasite of *Lymantria monacha*.

Members of the genus *Dolichomitus* are parasitic on wood boring Coleoptera, and not on *Lymantria*. Dalla Torre (1902) cited *L. monacha* as a host, referring to Ratzeburg (1844), who however, mentioned "*Curculio pini*" as a host and not *Lymantria*. Also cited as *Ephialtes tuberculatus* by some authors.

3. *Iseropus roborator* (Fabricius)

Meyer (1936, pt. 6: 296-297) mentioned this species as a parasite of *Lymantria dispar* and *L. monacha*. However, in his taxonomic treatment of this species (1934, pt. 3: 22), the only host mentioned was *Ostrinia nubilalis*. There is no subsequent record confirming its association with the gypsy moth. This species properly belongs to the genus *Exeristes* and is widely distributed in southern Europe and the Mediterranean area.

KEY TO THE TRIBES AND GENERA OF PIMPLINAE ASSOCIATED WITH THE GYPSY MOTH

1. Mesopleural suture straight, without a distinct angulation, the area before it not depressed. When hind tibia banded, apical and basal dark bands and a median pale band — the extreme base of tibia dark. (Tribe Ephialtini). 2
- Mesopleural suture with a weak angulation near middle. Mesopleural pit area depressed. When hind tibia banded, there are apical and sub-basal dark bands and median and basal pale bands—the extreme base of tibia thus pale. 4
2. Inner margin of eye weakly concave above antennal socket. Face of male black. Tarsal claws of female without a basal tooth.
 1. Coccygomimus (= Pimpla of authors)
 Inner margin of eye rather strongly concave opposite antennal socket. Face of male white, yellow or black. Fore tarsal claws of female with a large basal tooth. 3
3. Ovipositor straight. Face and orbits of both sexes black. . 2. Itoplectis
 Ovipositor hooked downwards at tip. Face of male largely or entirely white or yellow. Orbits of female narrowly whitish in front.
 3. Ephialtes
4. Tarsal claws of female, or at least the front claws, with a basal tooth. Male subgenital plate wider than long. Body black or with black stripes. (Tribe Pimplini). 5
 Tarsal claws of female without a basal tooth. Male subgenital plate longer than wide. Body yellow or brownish-yellow. (Tribe Theroniini).
 4. Theronia
5. Nervellus intercepted below the middle, rarely at middle. Ovipositor sheath shorter than fore wing. First intercubitus of areolet shorter than the second. Areolet wider than high, triangular, and receiving second recurrent vein at apical corner. Propodeum with short median carinae at base. 5. Acropimpla
 Nervellus intercepted at or above the middle. Ovipositor sheath as long as or longer than fore wing. Areolet variable. 6. Iseropus

6. Face of male white or yellow; clypeus of female usually red. Clypeus weakly convex sub-basally, weakly depressed apically. Nervellus intercepted near its upper 0.33. Ovipositor 0.5 as long as fore wing. Ocellar triangle narrow. Interocellar distance a little less than ocellocular distance (0.8 to 0.9:1). 6a. Iseropus (Iseropus)
- Face of male and clypeus of female black. Clypeus strongly convex sub-basally and depressed apically. Nervellus intercepted between its upper 0.4 and center. Ovipositor 0.6 to 0.8 as long as fore wing. Ocellar triangle wider. Interocellar distance a little more than ocellocular distance (10:8). 6b. Iseropus (Gregopimpla)

Tribe EPHIALTINI

Members of the tribe Ephialtini have the clypeus usually a little swollen basally and flattened apically, mesoscutum without transverse wrinklins, prepectal carina complete, mesopleural suture without an angulation near the middle or sometimes with a weak angulation, propodeal carinae absent to more or less complete (*Xanthopimpla*), propodeal spiracle elongate, areolet present, nervellus intercepted usually above the middle, first tergite short, its lateral carina usually strong, and ovipositor stout, long or short, with its tip a little depressed.

The members of this tribe are common throughout the world. They are usually internal parasites of exposed or semi-exposed pupae of Lepidoptera. Species of *Itoplectis* are sometimes secondary parasites. Oviposition is into the prepupa or pupa and the emergence is from the pupa. The host range of an individual species is wide. The males are usually smaller than the females. There is one parasite per pupa. They overwinter in the host pupa, or species of *Itoplectis* sometimes overwinter as adults.

Three genera, *Coccygomimus*, *Itoplectis* and *Ephialtes*, are associated with the gypsy moth, but only species of *Coccygomimus* appear to be of some importance in the control of the pest.

1. Genus COCCYGOMIMUS (Fig. 1)

Coccygomimus Saussure, 1892. In Grandidier: Histoire Physique Naturelle et Politique de Madagascar, 20 (Hyménoptères), Part 1, Pl. 14, Fig. 12.

This genus is often called erroneously as *Pimpla* by various authors. For synonymical references, refer to Townes (1969). Townes and Townes (1960) treated the Nearctic species, and Kasparyan (1974) reviewed the Palearctic species.

Moderately large-sized insects with fore wing 3.2 to 17.5 mm. long. Antenna slender, thin and long. Inner margin of eye only weakly emarginate above antennal socket. Malar space usually long. Mandibular teeth of almost equal length. Notauli weak or absent. Propodeum and metapleurum usually with coarse punctures and some striation. Median longitudinal carinae of propodeum usually present basally. Tarsal claws large, simple, without a basal tooth or an enlarged hair with a flattened tip. Abdomen usually closely punctate (sometimes impunctate). Ovipositor straight, long and stout.

Members of the genus *Coccygomimus* are solitary, internal parasites of prepupae and pupae of various Lepidoptera found beneath leaf litter. The development is completed within the host pupa. They are polyphagous and

multivoltine. Some species overwinter within the host pupa. All species give off a strong pungent odor when captured.

Various species of *Coccygomimus* have been recorded as parasites of *Lymantria dispar* in Eurasia, Japan and North America. There have been many misdeterminations in the past. The following species have been confirmed by various authors as parasitic on the gypsy moth by rearings:

1. *C. instigator* (Fabricius). Eurasia.
2. *C. pedalis* (Cresson). North America.
3. *C. turionellae* (L.). Eurasia. Introduced in North America.
4. *C. moraguesi* (Schmiedeknecht). Morocco. Introduced in U.S.A.
5. *Coccygomimus disparis* (Viereck) (= *C. porthetriae* Viereck). Japan.
6. *C. luctuosus* (Smith). Japan. This species was misidentified by Howard and Fiske (1911) as *C. pluto*.

Many of the above species are being cultured in the U.S.A. for field releases. Metterhouse (in Doane and McManus, 1981: 363-365) provided some biological information on these species.

Species of *Coccygomimus* that have been reported erroneously as parasites of the gypsy moth are:

1. *Coccygomimus aethiops* (Curtis) (= *parnarae* Viereck = *aterrima* Gravenhorst). Europe.

Thompson (1946) listed this species as a parasite of the gypsy moth, citing Stadler (1933) and Schedl (1936). These authors did not list this species. It is also not listed as a parasite of the gypsy moth in the recent catalogs of Oehlke (1967) and Aubert (1969).

C. aethiops is a rather distinct species, wholly black, closely, coarsely punctate, and dull body sculpture. It belongs to the Turionellae Group and is somewhat related to *C. pluto* and *C. luctuosus*.

2. *Coccygomimus pluto* (Ashmead). Japan

This species was reported as a parasite of *Lymantria dispar* by Howard and Fiske (1911), who reared it from pupae received from Japan during 1908-1910. I have seen a female with the data, 'Ex. *Porthetria dispar* Linn., Japan, July 1908, Gip Moth Lab 1650', bearing a determination label, '*Pimpla pluto* Ashm.' by Viereck. This is actually a specimen of *Coccygomimus luctuosus* (Smith) which is very closely related to *pluto*. These two species have often been confused in the past. *C. pluto* has not been subsequently reared nor mentioned as a parasite of the gypsy moth, except by cataloguers like Thompson and Schedl, who based their information on Howard and Fiske. This species should therefore be deleted from the list of the gypsy moth parasites. Kasparyan (1974) provides a diagnostic key to separate the three very similar looking species: *parnarae* = *aethiops*, *pluto* and *luctuosus*.

3. *Coccygomimus tenuicornis* (Cresson). U. S. A.

Howard and Fiske (1911: 138) stated, 'Recorded as a parasite [of gypsy moth] by Forbush and Fernald, but never reared at the Laboratory. Possibly *P. conquisitor* was actually the species reared.'

Thompson (1946), quoting Schedl (1936), reported it from Japan and U.S.A.

Simons et al. (1979: 31) have the following entry under *C. tenuicornis* (Cresson):

"Riley and Howard (1894) reported occasional parasitism of the gypsy moth. However, this was probably a misidentification of *C. pedalis* (Cresson) or *Itopectis conquisitor* (Say) (Carlson, 1978)."

It is not a parasite of the gypsy moth.

4. *Coccygomimus* sp.

Picard (1921) reported this species from France. Its identity is uncertain without Picard's specimens. It can be any of the known European species of *Coccygomimus* parasitizing the gypsy moth.

5. *Coccygomimus* sp.

Herard and Fraval (1980) reported this from pupae of the gypsy moth from Morocco. Its identity uncertain.

The species of *Coccygomimus* that have been reported from other *Lymantria* species are:

1. *C. arcticus* (Zett.) from *L. monacha*. Europe.
2. *C. instigator* (Fab.) from *L. monacha*. Europe.
3. *C. contemplator* (Mueller) from *L. monacha*. Europe.

Prior to 1932, specimens determined as *contemplator* were called *turionellae* L. Several species have been mixed up under *contemplator* and it is not certain whether true *contemplator* is parasitic upon *Lymantria monacha*.

4. "*Pimpla dentata* Thomson" from *L. monacha*. Europe.

Tragardh (1920) reported "*Apechthis dentata* Thomson" as a parasite of *Lymantria monacha* for the first time from Sweden. Kolubajiv (1937) indicated that "*dentata* Thomson" was a lapsus for *Pimpla quadridentata* Thomson. This species is now placed in *Ephialtes*.

5. *C. turionellae* (L.) from *L. obfuscata*. India.
6. *C. disparis* (Viereck) from *L. obfuscata*. India.
7. *C. laothoë* (Cameron) from *L. obfuscata*. India.

Rao (1966) mentioned two "*Pimpla* sp." as parasites of pupae of *L. obfuscata* in Kashmir and Kotgarh. In 1972 he reported three species, *C. turionellae*, *C. sp. nr. turionellae*, and *C. laothoë* from *L. obfuscata*. I have checked these specimens. The specimens from Kashmir represent *C. turionellae* and *C. disparis* (= *C. sp. nr. turionellae* of Rao). A female from Chimla, H. P., July 20, 1964, Kotgarh substation, det. as *Pimpla poesia* Cam. by Kerrich, is *C. laothoë* (Cameron), *C. poesia* is a synonym of *C. laothoë*.

KEYS TO THE SPECIES OF COCCYGOMIMUS PARASITIC UPON THE GYPSY MOTH PLUS THOSE OFTEN CONFUSED WITH THEM

Females

1. All legs, including their coxae, black. Eastern Palaearctic. Two species of the *Turionellae* Group. 2
All legs not wholly black, either coxae or femora and tibiae red or orange-yellow. 3
2. Body length 12-14 mm. Body pubescence brownish. Face with scattered punctures, shiny in between. Mesopleurum with well separated shallow

- punctures. Tergite 5 with shallow, not well formed punctures. Hind coxa subpolished, mat. Propodeum punctate. Whole body more subpolished with shallower punctures. Japan (wrongly associated with the gypsy moth). pluto (Ashmead)
 Body length 15-20 mm. Body pubescence whitish or golden. Face strongly punctate. Mesopleurum strongly punctate. Tergite 5 with coarse, well formed punctures. Hind coxa punctate. Propodeum rugose to rugoso-reticulate centrally. Whole body dull with coarse punctures. Japan.
 6. luctuosus (Smith)
3. All legs including coxae, red. Scutellum red. Hind tibia with a distinct white band, its basal half fuscous. Hind tarsus black. Mesopleural punctation coarse. Morocco. 4. moraguesi (Schmiedeknecht)
 All coxae black or at least one pair of coxae black to blackish. Scutellum black (sometimes yellow in *laothoë*). 4
4. All coxae black. All femora reddish-brown or orange-brown. 5
 Hind coxa reddish or yellowish-brown. Fore coxa black, or blackish-brown. Middle coxa yellowish-brown or black. Femora reddish-brown. 8
5. Body pubescence brownish. Hind tibia (and femur) wholly rufous, without a white annulus. First tergite strongly to weakly pyramidal in profile. Tegula black or yellow. Epipleura narrow. Fourth epipleurum about 3.0 as long as wide. (Instigator Group). Length 12 to 18 mm. 6
 Body pubescence white. Hind tibia with a pale submedian band or wholly black. First tergite short, not pyramidal in profile, without strong or distinct humps. Epipleura wider. Fourth epipleurum the widest, about 2.5 as wide as long. (Turionellae Group). Length 9-15 mm. 7
6. Tegula black. Dorsal humps on tergite 1 prominent. Mesopleurum not densely punctate, interspaces about 1.0 to 1.5 the diameter of punctures. Eurasia, Japan, Iran, and Morocco. 1. instigator (Fabricius)
 Tegula yellow to orange-brown. Dorsal humps on tergite 1 weaker. Mesopleurum densely punctate, punctures largely contiguous, or interspaces less than the diameter of the punctures India, *ex Lymantria obfusca*. laothoë (Cameron)
7. Hind tibia with a submedian pale band, or spot, or rarely wholly reddish. Hind femur fuscous apically. Hind corner of pronotum yellow. Abdomen with coalescing punctures, a little coarser than in disparis. Length 9-12 mm. Palaearctic and Oriental Regions.
 3. turionellae (Linnaeus)
 Hind tibia wholly black. Hind femur with a distinct black apical ring which may be as wide as 0.2-0.25 the length of femur. Hind corner of pronotum without yellow mark (only the postspiracular sclerite yellow). Abdomen punctate but not coarsely so, punctures rather well formed and smaller. Length 12-15 mm. Japan and India. Introduced in U. S. A. and possibly established in Pennsylvania. 5. disparis (Viereck)
8. Fore and middle coxae black or brownish-black. Hind coxa reddish or yellowish-brown. (Parasites of *Lymantria monacha*). 9

- Fore coxa black or brownish-black. Middle and hind coxae orange or yellowish-brown. (Parasites of *Lymantria dispar*). 10
9. Body 12-15 mm. long. Body pubescence brownish. Hind tibia brownish-yellow, without any pale band. Propodeum trans-striate, with strong basomedian carinae bounding a finely striate basal area. First tergite with dorsal humps. Epipleura narrow. (Instigator Group). Europe. arcticus (Zetterstedt)
Body 8-10 mm. long. Body pubescence white. Hind tibia with a submedian pale band. Propodeum with a smooth basal area bounded by weak interrupted carinae. First tergite flat, without dorsal humps. Epipleurae, particularly 4th and 5th, wide. (Aequalis Group). Europe. contemplator (Mueller)
10. Body 12-18 mm. long. Pubescence brownish. Epipleura narrow. First tergite conical, with dorsal humps. Hind tibia and tarsus black. (Instigator Group). North America. 2. pedalis (Cresson)
Body 8-10 mm. long. Pubescence whitish. Epipleura wide. First tergite flat dorsally, without humps. Hind tibia and tarsus brownish, with a faint suggestion of a submedian band on tibia. Hind tibia sometimes rufous. (Aequalis Group). Europe. 7. spurius (Gravenhorst)

Males

1. All coxae red. Legs in general red. Hind tibia with a yellow subbasal band. Hind tarsus black. Hind tibia sometimes a little fuscous. Scutellum red. Morocco. 4. moraguesi (Schmiedeknecht)
All coxae and legs never wholly red. Scutellum black or yellow marked. 2
2. All coxae wholly black. Body pubescence various. Tyloids present or absent. 3
Middle coxae black or yellowish-brown. Hind coxa wholly or partly yellowish-brown. Body pubescence brown. Tyloids absent. Hind tibia and tarsus black. 9
3. Hind femur black. 4
Hind femur red. 5
4. Flagellar segments 6-9 with tyloids. Wing bases yellow. Scutellum with a yellow spot. Body pubescence usually whitish, sometimes brownish. Fore and middle tibiae and femora with yellow marks. Mesopleurum coarsely punctate. Length 10-15 mm. Japan. luctuosus (Smith)
Flagellar segments 6-7 (only) with tyloids. Wing bases black, though tegula brown. Body pubescence white. Scutellum black. Fore femur and tibia with brownish marks. Mesopleurum smoother. Length 8-10 mm. Japan. 6. pluto (Ashmead)
5. Tyloids absent. Body small and slender, less than 10 mm. long. Hind tibia with a distinct submedian white band. 6

- Tyloids present on flagellar segments 6-7, 6-9 or 6-11. Body medium-sized, over 10 mm. long. Hind tibia brownish, brownish-red, or black, with or without a whitish band. 7
6. Tergite 6 mat. Tegula whitish-yellow. Subapical band on hind tibia sharply demarcated from the black tibia. Europe. . . . contemplator (Mueller)
Tergite 6 coarsely punctate on front half. Tegula yellow, with a brown spot. Subapical band on hind tibia with indistinct boundaries. Hind tibia brownish. Europe. 7. spurius (Gravenhorst)
7. Body pubescence brown. Tyloids present on flagellar segments 6-11. Tegula black, or with a large yellow spot. Hind femur without any apical black mark. Hind tibia brownish-red. Body 8-15 mm. long. Eurasia. 1. instigator (Fabricius)
Body pubescence whitish. Tyloids present on flagellar segments 6-7 only. Tegula yellow. Hind femur black apically. Hind tibia brownish or black, with or without a white band. 8
8. Hind corner of pronotum yellow. Hind tibia black and with a distinct yellowish-white submedian band. Mesopleural sculpture smoother. Length about 9-12 mm. Eurasia. 3. turionellae (Linnaeus)
Hind corner of pronotum black. Hind tibia blackish or blackish-brown, without a distinct yellow band. (Sometimes there is a faint suggestion of a band). Mesopleural sculpture coarser. Length about 12-13 mm. Japan and India. Introduced in U. S. A. and possibly established in Pennsylvania. 5. disparis (Viereck)
9. Middle and hind coxae yellowish-brown. Face comparatively smoother. North America. 2. pedalis (Cresson)
Middle coxa black. Hind coxa orange-brown dorsally and black ventrally. Face more distinctly punctate. Europe. arcticus (Zetterstedt)

1. COCCYGOMIMUS INSTIGATOR (Fabricius) (Figs. 9, 15, 21, 27, 33)

Ichneumon instigator Fabricius, 1793. Entomologia Systematica, 2: 164. Germany.

Pimpla instigator Gravenhorst, 1818. Nov. Acta Physio Medica Acad. Caesareae Leopoldino-Carolinae Nat. Curio, 9: 291.

Apechthis flavipes Matsumura, 1912. Thousand Insects of Japan, Suppl. 4: 144. Japan.

Coccygomimus instigator: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 51. China, Japan, Korea, Kuriles, Sakhalin, Russia, and Europe. Several host records from Eurasia.

The earliest record of this parasite from the gypsy moth can be traced to Rondani (1873) in Europe. Rudow (1911) mentioned it as a parasite of *Lymantria dispar*, *L. monacha*, *Euproctis similis* and *E. chrysorrhoea*. Carlson (1979) lists several synonyms.

Female: Face closely punctate, with a median ridge. Frons rather deeply excavated, shiny, with minute punctures and a few trans-striations. Mesoscutum somewhat shallowly punctate, shiny in between punctures. Scutellum shiny, with a few scattered minute punctures. Mesopleurum with deep punc-

tures, tending to be punctato-striate along mesopleural suture. Punctures not dense, separated by about 1.0 to 1.5 their diameter. Metapleurum rugoso-striate in anterior half and distinctly striate posteriorly, including the prominent submetapleural flattened ridge. Propodeum rugoso-reticulate to rugoso-striate, without median carinae, apically shiny. First tergite pyramidal in profile, with distinct dorsal humps, its apical half coarsely punctate, tending to be rugose laterally. Second tergite coarsely punctate. Tergites 3-5 punctate, punctures tending to be smaller progressively rearward, the following tergites mat, subpolished. Hind coxa punctate. Tarsal claws broad, apically strongly decurved. Fourth segment of fore tarsus strongly notched ventrally. Nervulus slightly distad of basal vein. Epipleura 2 and 3 narrow. Fourth epipleurum a little wider, rectangular, about 3.0 as long as wide.

Black. All coxae and trochanters black. All femora and tibiae orange-brown, their tarsi brownish, with apical segments fuscous. Sometimes hind tarsus wholly fuscous. Hind tibia without a pale band. Body pubescence brownish. Tegula black.

Male: Similar to the female in sculpture and color, but with fuscous hind tarsus, or hind tarsus often black. Tegula black or with a yellow spot. Flagellum with tyloids on segments 6-9, 6-10, or 6-11.

Length: Male 8-15 mm. Female 15-18 mm. Fore wing 6-13 mm.

Specimens: 8♀, 4♂, bred from gypsy moth at Melrose Highlands Lab., from pupae received from Hungary (Baja), July 1925; Austria, August 1907; France, August 1910; Germany, August 1909; and Italy, August 1911 (Forest Insect Laboratory, Hamden, Ct.). South Rumania, 1♂, 1♀, June 26-28, 1978, *ex Lymantria dispar*, R. C. Hedlund. Poland 1♂, August 1, 1975. Morocco, North Kemitra, Mamora Forest, 1♀, July 13, 1974, *ex Lymantria dispar*, A. Fravel (all B.I.R.L., Newark, Delaware). 3♂, 3♀, bred at Trenton, N. J., from stock from Yugoslavia *ex Lymantria dispar* (N.J. Dept. Agriculture, Trenton). Several European specimens seen in Townes collections (not reared).

Distribution: Widespread in Eurasia and Japan. Also occurs in North Africa. It has been reared from gypsy moth pupae in Iran and Morocco (Herard *et al.*, 1979, 1980).

Hosts: Several hosts have been recorded in Europe and Japan, for which reference may be made to Townes *et al.* (1965) and Aubert (1969).

Coccygomimus instigator belong to the Instigator Group as defined by Townes and Townes (1960). It is close to the Oriental *C. laothoë* (Cameron), the European *C. arcticus* (Zetterstedt), and the Russian *C. palmiricus* (Kasparyan). In *C. laothoë* the mesopleural sculpture is denser and tegula orange-brown to yellow. It is parasitic on *Lymantria obfuscata*. *C. arcticus*, a parasite of *Lymantria monacha*, has smoother and shiny thorax, with mesoscutum leathery, almost impunctate, and hind leg wholly orange-brown, with its tarsus sometimes a little fuscous. The male has black coxae, but the tyloids are absent. *C. palmiricus* is distinguished by its dark red hind femur, narrower tarsal claws, which are apically less decurved, and fourth segment of fore tarsus weakly notched ventrally.

Biological notes: Howard and Fiske (1911: 237) recorded that this species was received in considerable numbers from Europe in shipments of brown tail moth pupae during 1906 to 1909. During that time it was liberated in New England states for control of the gypsy moth. It was, however, not recovered. During 1973-79, 3,250 specimens of this species were released in Pennsylvania from stocks from Yugoslavia. No recoveries have so far been reported.

Györfi (1963: 51) mentioned *C. instigator* as an important parasite of

Lymantria dispar in Hungary. Romanyk (1965: 34) mentioned that it has been known as a gypsy moth parasite in Spain for a long time, but without having had any great impact on the gypsy moth population there. The only exception noted by him was its abundance during 1960-61, in a small gypsy moth infestation on Minorca Island, where about 20% of the pupae were destroyed by this parasite. Drea and Fuester (1979) reported that in Poland it was parasitizing 1.3 to 3.7% of the pupae in 1975.

Howard and Fiske (1911) mentioned that its biology was similar to that of *C. pedalis* and *C. turionellae* but that *instigator* had a tendency to hibernate within the host pupa. They also mentioned its becoming hyperparasitic on occasions on *Iseropus coelebs* (Walsh) [= *Pimpla (Epiurus) inquisitoriella* D. T.]. It is a polyphagous, multivoltine species.

2. COCCYGOMIMUS PEDALIS (Cresson) (Figs. 11, 17, 23, 29, 35, 123)

Pimpla pedalis Cresson, 1865. Proc. Ent. Soc. Philadelphia, 4: 268.
Colorado, U. S. A.

Pimpla pedalis: Fernald, 1892. Bull. Hatch Exp. Sta. Mass. State Coll., 19: 116. Massachusetts. Host: *Lymantria dispar*. Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 137-138, 237-239. Biol.

Coccygomimus pedalis: Townes, 1944-45. Mem. Amer. Ent. Soc., 11: 62-63. Synonymical references. Host records.

This is a polyphagous parasite, first recorded from the gypsy moth in the U. S. A. by Fernald (1892). Townes (1944-45) has given a full list of hosts. Carlson (1979) provides further taxonomic and biological references. It is one of the native North American parasites of the gypsy moth.

Female: Face dull-shiny, convex, with small, scattered punctures, punctures denser close to antennal sockets. Frons excavated, subpolished, without striations. Mesoscutum and mesopleurum shiny to subpolished, with minute scattered punctures. Scutellum subpolished. Metapleurum shiny and with weak oblique striations. Submetapleural projection narrow and much less pronounced than in *instigator*. Propodeum leathery, punctate laterally and trans-striate centrally. Sculpture much weaker than in *instigator*. Median propodeal carinae faintly to distinctly visible in basal half and diverging apically. Hind coxa impunctate. Nervulus slightly distad of basal vein. First tergite somewhat conical, with dorsal humps, which are blunt. Apical half of first tergite (except for its apical margin) with coalescing punctures. Second, third and fourth tergites punctate. The following tergites progressively less punctate to mat. Abdomen shiny between punctures. Epi-pleura narrow, those of 4th and 5th tergites narrower than in the preceding species.

Black. Body pubescence brown. Tegula black. Fore coxa black to brownish-black. Fore leg otherwise yellowish-brown. Middle leg wholly yellowish-brown. Hind coxa, trochanters, and femur yellowish-brown to orange-brown. Hind tibia and tarsus wholly black, without any bands. Hind femur fuscous apically.

Male: Similar to the female, but face more closely punctate. Frons with scattered punctures. First tergite less conical. All legs yellowish-brown with fore coxa yellowish apically and hind tibia and tarsus wholly black. Flagellum without tyloids.

Length: 12-15 mm. Fore wing 8-12 mm.

Specimens: U.S.A.: Whiteford, Harford Co., Md., 1♀, June 30, 1981, ex pupa of *Lymantria dispar*, R. Tateman (BIRL, Newark, Delaware). Winters State Park, Pa, 1♂, ex *L. dispar*, July 17, 1975 (Delaware). Schuylkill Co., Tremont Township, Pa. 1♂, 1♀, July 4, 1974 (Bureau of Forestry, Pennsylvania). North Saugus, Mass., 1♀, ex *Lymantria dispar*, Gypsy Moth Lab. (F.I.S., Hamden).

Distribution: Common in Transition and Canadian zones in North America.

Coccygomimus pedalis belongs to the Instigator Group and is readily distinguished from *C. instigator* by its smoother thorax, and impunctate hind coxa. It is related to *C. arcticus* in having brown body pubescence, red hind coxae and by the absence of tyloids on the male flagellum. The general body sculpture of the two is also similar, but *arcticus* has a more striate propodeum. In *pedalis*, the middle coxae are yellowish-brown and face smoother, while in *arcticus*, the middle coxae are black and face comparatively more punctate. The two may be considered subspecies (Townes, 1940).

Coccygomimus pedalis is a polyphagous multivoltine species, overwintering within the prepupa in the host pupa. It is one of the native prepupal or pupal parasites of the gypsy moth, but parasitism is not common. It is therefore not considered important. There are two to three generations per year. It takes about three weeks to complete its development within the host pupa. It attacks several other hosts (Townes, 1945; Carlson, 1979). Campbell (1963) observed it attacking gypsy moth pupae and prepupae in Glenville, New York State. He found that although parasitism was scarce, it killed more pupae and prepupae through stinging than those successfully parasitized. These stung pupae and prepupae were subsequently infested by sarcophagid larvae which acted as scavengers. He observed that *pedalis* was common in the field and exerted a great influence on the population of the gypsy moth by killing the prepupae and pupae rather than by successfully parasitizing them.

3. COCCYGOMIMUS TURIONELLAE (Linnaeus) (Figs. 7, 13, 19, 25, 31, 124)

Ichneumon turionellae Linnaeus, 1758. Systema Naturae, 10: 1: 564.

Europe.

Pimpla turionellae: Gravenhorst, 1818. Nova Acta Physico Medica Akad. Caesareae Leopoldino-Carolinae Nat. Curio, 9: 291.

Cryptus examinador Fabricius, 1804. Systema Piezatorum, p. 85. Austria.

Pimpla examinador: Ratzeburg, 1844. Die Ichneumoniden der Forstinsecten, 1: 116. Germany. Hosts: *L. monacha* and others.

Coccygomimus turionellae: Townes and Townes, 1960. U. S. Natl. Mus. Bull., 216(2): 323. Synonymy and other references.

This species has often been referred to as *Pimpla examinador* in gypsy moth literature. Howard and Fiske (1911) mentioned having reared it in the laboratory from both the gypsy moth (*Lymantria dispar*) and the brown tail moth (*Euproctis chrysorrhoea*). It was received in the U. S. A. in considerable numbers in shipments of brown tail moth pupae from Europe and was released in the field during 1906-1909, but not recovered.

Carlson (1979) provides further biological references. Aubert (1969) and Oehlke (1967: 32) give all synonymical references.

Male and female: Male flagellum with tyloids on segments 6 and 7. Face largely rugulose to ruguloso-punctate, convex, more so in the male. Frons excavated, punctato-striate. Interocellar distance 1.5-1.8 the ocellocular

distance. Ocellocular distance about half the ocellar diameter. Ocellar area smoother. Mesoscutum punctate. Punctures dense, small, but not coarse, areas between them subpolished. Scutellum flat to subconvex, punctures sparse. Scutellum punctate. Mesopleurum punctate, punctures coarser than on mesoscutum, well separated with interspaces shiny, on lower half with well separated but larger punctures. Metapleurum finely punctato-striate, the striations extending over flattened and expanded submetapleural ridge. Propodeum convex, rugoso-striate on basal half, without any median carinae, except rarely at base. Extreme base of propodeum in the middle, and apical half of propodeum polished to subpolished, the basal smooth area often depressed. Hind coxa punctate. Nervulus interstitial. First tergite short and wide, convex in profile with weak humps, not conically produced medially. Postpetiole largely shiny with scattered punctures. Abdominal tergites 2 to 4 closely punctate, with shiny interspaces. Apical tergites finely punctate to mat. Apical margins of tergites shiny. Epipleura of tergites 1-3 narrow, of tergites 4-5 wider, that of 4th the widest.

Black. Body pubescence white. Tegula and hind corner of pronotum yellow. All coxae black, trochanters blackish-brown, and femora reddish-brown. Fore and middle tibiae and tarsi yellowish-brown, with tibiae fuscous dorsally and with a pale band or streak. In male tibiae and tarsi paler. Hind tibia black and with a distinct yellow submedian band. Hind tarsus black. Hind femur fuscous apically. Some males from USSR have the hind tibia wholly reddish. Sometimes apices of abdominal tergites, particularly in males, brownish.

Length: 9-12 mm. Fore wing 7.5 to 10 mm.

Specimens: Germany, 1♀, bred from *Lymantria dispar* at Gypsy Moth Lab., Sept. 30, 1907 (Hamden). S. Rumania: 2♂, *ex Lymantria dispar*, EPL-78-71, June 26-28, 1978, R. C. Hedlund (BIRL, Newark). 2♂, 9♀, reared at Trenton, N.J. *ex Lymantria dispar*, 1973-1975, presumably from stocks from India (BIRL, Delaware), 2♂ (Bureau of Forestry, PA). Imported in the U.S.A. from India and Rumania (cf. computer printout of BIRL, Delaware). India: Kashmir: Srinagar, 1♂, 1♀, July, 1964, *ex Lymantria obfus-cata* (CIBC, Bangalore). Several males and females from Europe (Townes).

Coccygomimus turionellae resembles superficially *C. instigator*, from which it can be readily distinguished by its white pubescence and black hind tibia having a yellowish-white annulus. It is a comparatively smaller sized species with finer body sculpture. It has wide fourth and fifth epipleura (Turionellae Group).

Distribution: Widely distributed in the Palaearctic and Oriental Regions. Imported into North America several times during 1906 to 1979 from Europe and India. Apparently not established. Recent rearing records from the gypsy moth are by Vasic (1958), Yugoslavia; Rao (1972), India; and Hedlund and Mihalache (1980), Rumania.

Hosts: Several hosts are known in Europe, USSR and Japan (Townes, Momoi and Townes, 1965), Šedivý (1963). It is a polyphagous parasite of Lepidoptera and Coleoptera.

Biological Notes: Several thousand specimens of this species were released against the gypsy moth in Pennsylvania during 1973-79, bred in the laboratory from specimens of Indian origin. According to Pennsylvania Bureau of Forestry Report (? 1979), it was not recovered during subsequent years. Carlson (1979: 346) provides a historical record of its introductions in Eastern North America and Canada during 1906-1955. The target hosts in North America were introduced pests, like *Lymantria dispar*, *Rhyacionia*

buotiana, *Cydia* (*Cydia*) *pomonella* and *Operophtera brumata*. A number of native pests were target hosts also for some of the introductions. Establishment has apparently not occurred, although a few recoveries have been reported in Ontario, Canada.

Rao (1966) provides some information on the life history of this species under "*Pimpla* sp." reared in Kashmir, India, from pupae of *Lymantria obfuscata*. Two generations were observed in Kashmir. The adults of the first generation appeared in early May and those of the second generation in late June. Mating occurred readily between freshly emerged males and older females, lasting 35 seconds to one minute. Pre-oviposition period is 3-4 days. Oviposition is in freshly formed pupae and takes two to two-and-a-half minutes. Generally a single egg is laid at a time. The egg measures 2.0 x 0.35 mm., and is round at one end and tapering at the other. Soon after oviposition the female feeds upon the oozing fluid from the puncture. The egg hatches in about 2 days. Larval period is 9-11 days. The first larval instar is 2.5 mm., and the fully grown larva is 7-13 mm. long. Pupation occurs inside the host pupa. The pupal period is 7-8 days. The adult males and females lived in the laboratory for about 25 and 40 days, respectively. The ratio of males to females was 1:3. Only one parasite develops per host.

Metterhouse (in Doane and McManus, 1981) has also provided biological information on this species apparently based upon his observations during culturing it in the laboratory. His data differ only slightly from what has been given by Rao from field studies. The biology of *C. disparis*, *instigator* and *moraguesi* is similar to that of *turionellae*.

In the field collected pupae of the gypsy moth, the larvae and pupae of *Monodontomerus* sp. were seen with the remains of "*Pimpla* sp" larvae.

Rao (1972) reported three species of *Coccygomimus* from *Lymantria obfuscata* in Kashmir and Kotgarh, India. These three species, confirmed after examining the specimens, are *C. turionellae*, *C. disparis* and *C. laothoë*. He reported that the aggregate parasitism by the three species was generally low in all the four localities studied in Kashmir. The percentage parasitism was 0.45 to 12.58% in 1968-69 and 1.36% in 1971. However, in 1970, the parasitism was reported to be 17.35 to 67.41 percent.

4. COCCYGOMIMUS MORAGUESI (Schmiedeknecht) (Figs. 8, 14, 20, 26, 32)

Pimpla Moraguesi Schmiedeknecht, 1888. Zool. Jahrb., 3: 479. Morocco.
Coccygomimus turionellae moraguesi: Oehlke, 1967. Hymenopterorum
 Catalogus, 2(1): 32.

Coccygomimus moraguesi has usually been referred to as *C. turionellae moraguesi* in gypsy moth literature in the U. S. A. It is mentioned in the reports of the Pennsylvania Bureau of Forestry, among the 15 exotic parasites that were released against the gypsy moth in Pennsylvania since 1973. Carlson (1979) states that *Pimple freyi* Hellen from the Canary Islands is probably a synonym of it. Both *moraguesi* and *freyi* were treated by Aubert (1969) as synonyms of *turionellae*.

Simons *et al.* (1979) differentiated *C. turionellae moraguesi* from *C. turionellae turionellae* by stating that the former species has hind coxa and disc of scutellum reddish, while the latter species has both these structures black. Both taxa have a yellow or yellowish-white sub-basal band on hind tibia. I find that the body sculpture of *moraguesi* is coarser than that of *turionellae*, justifying separation as a species.

Male and female: Essentially similar and related to *C. turionellae* and differing as follows: Face distinctly punctate. Punctures coarse, tending to run into striations near antennal sockets. Face with a median smooth raised ridge in female and a convex median punctate area in male. Frons excavated, largely striate and punctate laterally. Ocelli larger than in *turionellae*, closer to the eye. Interocellar distance 2.0 to 2.3 the ocellocular distance. Ocellocular distance 0.3 the ocellar diameter. Thorax closely and coarsely punctate, with scutellum convex and smoother, sometimes with minute scattered punctures. Mesopleural punctures rather coarse and close together. Metapleurum coarsely punctato-striate, sometimes tending to be rugoso-striate in female. Propodeum rugoso-striate with short median carinae at base. Abdomen coarsely punctate. Postpetiole densely punctate.

Black. Tegula and hind corner of pronotum yellow. Tegula of female often black on apical half. Scutellum, metascutellum and all legs reddish. Fore and middle tibiae with light fuscous marks. Hind tibia with fuscous basal and apical marks and a sub-basal yellow band. Hind tibia fuscous. Often middle tibia also with a yellow subbasal band. Fore tibia and tarsus sometimes with yellow lines, or tibia largely yellow in male. Abdominal tergites with reddish-brown margins.

Length: 9-13 mm. Fore wing 6-9 mm.

Specimens: Algeria, 1♀, bred from *Lymantria dispar* at Gypsy Moth Laboratory, No. 13029 (Hamden, Ct.) [det. as *Ephialtes* sp. by Muesebeck]. Morocco: North Kemitra, Mamora Forest, 1♀, July 13, 1974 A. Fraval, ex live shipment of *Lymantria dispar*. 1♂ 5♀, "Lab culture, Trenton, N. J." (BIRL, Delaware). 2♂ "Parasite Lab, Middletown, Pa." (Pennsylvania) and 5♂, ♀ (Trenton, N. J.). A computer printout received from BIRL, Delaware, indicates importation of this parasite in the U. S. A. from Morocco during 1976-77.

Biological notes: *Coccysgomimus moraguesi* is a polyphagous multivoltine parasite of pupae of various Lepidoptera (as are other *Coccysgomimus*). It is known from North Africa: Algeria and Morocco. Seyrig (1927) recorded it from Spain from *Malacosoma neustria*. Its biology is similar to that of *C. turionellae*.

A specimen from Algeria bred from *Lymantria dispar* at the Gypsy Moth Laboratory in Massachusetts prior to 1930, has been seen. It had remained unnoticed due to lack of specific identification. Only recently this species was introduced in the U. S. A. from Morocco and bred in the laboratory for field releases. According to Pennsylvania Bureau of Forestry Report, 5,600 specimens of it were released against the gypsy moth in Pennsylvania during 1973-79, but it has not established itself there.

5. COCCYGOMIMUS DISPARIS (Viereck) (Figs. 10, 16, 22, 28, 34)

Pimpla (Pimpla) disparis Viereck, 1911. Proc. U. S. Natl. Mus., 40: 480. Japan. Host: *Lymantria dispar*.

Pimpla (Pimpla) porthetriae Viereck, 1911. Proc. U. S. Natl. Mus., 40: 480. Japan. Host: *Lymantria dispar*.

Coccysgomimus disparis: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 48. Japan, Korea, China, Sakhalin.

Several taxonomical and biological references to this species are listed in Townes *et al.* (1965). Kasparyan (1974) records it from Mongolia, China, and USSR.

Male and female: Face closely punctate, punctures of moderate size and more regularly disposed. In female a smooth median raised area below antennal sockets. Male flagellum with tyloids on flagellar segments 6-7. Tyloid on 6th segment smaller. Frons excavated, faintly rugoso-striate. Mesoscutum with well separated punctures, interspaces shiny. Mesopleurum also with well separated punctures, but deeper than on mesoscutum, interspaces shiny. Scutellum a little elongate, laterally margined and punctate. Metapleurum rugoso-striate. Submetapleural ridge thinner, narrower and weakly striate. Propodeum rugose, with a few irregular striations centrally and smoother apically. Median carinae present basally or obliterated. When carinae present, the area in between them smooth. Hind coxa shallowly punctate. Nervulus interstitial. First tergite wide and flat apically, without dorsal humps, though medially convex in the female. Postpetiole densely punctate, smoother medially. Tergites 2-4 densely punctate, punctures coalescing. Tergite 5 onwards basally punctate and smoother apically, the punctures progressively becoming smaller to mat. Epipleura of tergites 4-5 wider than those of tergites 1-3, the fourth widest.

Black. Tegula yellow, often apically black marked. Postspiracular sclerite alone yellow near hind corner of pronotum. All coxae and trochanters black. All femora reddish-yellow. Hind femur black in apical 0.2 to 0.25. Fore and middle tibiae and tarsi yellowish-brown to orange, with faint fuscous marks on tibiae. Hind tibia and tarsus wholly black or blackish. Body pubescence white.

Length: 12-15 mm. Fore wing 10-12 mm.

Specimens: Japan, 1♂, 2♀ (paratypes, Nos. 13078), "Gypsy Moth Lab." (Washington). 1♀, Gypsy Moth Lab, No. 3309B. 1♀, Gifu, Japan, Y. Nawa Coll. (Washington). Japan, 1♂, *ex L. dispar*, Gypsy Moth Lab, No. 1650 (Hamden). Nishigahara, Japan, bred from *L. dispar* (labelled Paratype of *P. disparis* Vier.) (Hamden). Japan: Nara, Honshu, 1♀, *ex* Pupa, *Lymantria dispar*, June 23, 1977, P. Schaefer, emerged July 7, 1977 BIRL, (Newark). 1♂, 2♀, Lab reared in New Jersey Dept. of Agriculture from stocks from India (Pennsylvania) and 1♂ (Trenton). India: Srinagar, Kashmir, *ex Lymantria obfuscata* on willow, July 1963 (CIBC, Bangalore).

Distribution: Japan, Korea, China, Sakhalin, Mongolia, and India.

Hosts: Several host records, besides *Lymantria dispar*, are listed in references given in Townes *et al.* (1965) and Kasparyan (1974).

Coccygomimus disparis belongs to the Turionellae Group and is close to *C. turionellae* in the nature of pubescence, epipleura and general body sculpture. It differs from *turionellae* and *moraguesi* in having the hind tibia wholly black, without a white or yellow subbasal band, hind corner of pronotum not yellow (except for the postspiracular sclerite), tegula yellow, hind femur black in apical 0.3 ± 0.05 , and abdominal punctures well formed but not coarse. It is comparatively larger in size. The tyloid on the 6th segment of the flagellum of the male is smaller. The scutellum also appears distinctive.

Coccygomimus indra (Cameron) from India, belonging to the Instigator Group, has similar coloration of the legs, but the abdomen has sparse punctures, particularly on the second tergite.

Coccygomimus nigrcoxata Oehlke from Europe and USSR is also close to *disparis*, but differs in having coarser punctation on abdominal tergites with margins of punctures indistinct, especially on the apical half of fourth and whole of the fifth tergite. The interspaces between the punctures are mat, with indistinct fine sculpture. The hind femur is brownish or red with darker apex.

Biological notes: Although this parasite was received in the U.S.A. during

the first decade of the century, it has never been given serious attention because of the scanty material that was received. During 1973-79, this species was bred at the New Jersey Department of Agriculture, Trenton, from stocks from India and also bred and released in Pennsylvania by the Pennsylvania Bureau of Forestry. In one of their reports, it is stated that 73,215 specimens were released from stocks from Japan and India, but that it was never recovered except in the year of release. Metterhouse (in Doane and McManus, 1981), mentions that 10 specimens of this species were recovered in N.J. during 1978, but that the species is not yet known to be established in North America.

A recent letter from Dr. Fusco (Jan. 19, 1982) indicates that it was recovered in Bradford County, Pennsylvania, near Towanda on July 13, 1981. Two males of this species emerged from *Lymantria dispar* pupae collected there. No releases of *C. disparis* were made in 1979 or 1980 in that county. The closest release site was about 30 miles away in an adjacent county. The New York state border is rather close, where *C. disparis* was released in 1979 and possibly 1980, but not in 1981.

Rao (1966, 1972) gave some biological information on three *Coccygomimus* species, including the present species (see under *turionellae*).

6. COCCYGOMIMUS LUCTUOSUS (Smith)

Pimpla luctuosa Smith, 1874. Trans. Ent. Soc. London, 1874: 394.
Japan.

Coccygomimus luctuosus: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 53.

For full synonymical references, distributional records and host records (up to 1964) refer to Townes *et al.* (1965). Kasparyan (1974) provides a key to distinguish it from the Eurasian species.

This species is widespread in Japan, and Asian USSR and has also been reported from Korea, Taiwan, Sakhalin, etc. It has often been confused with *C. pluto* and *C. porthetriae* in the Japanese literature. Uchida (1930) and Matsumura (1931) reported it from *Lymantria dispar* (as *porthetriae*) in Japan. Yasumatsu and Watanabe (1964) include it in their list of parasites of the gypsy moth in Japan.

A female bred by Howard and Fiske (1911) in 1908 from pupae sent from Japan and determined as *pluto* by Viereck, actually belongs to this species, confirming the occurrence of this parasite on the gypsy moth.

Male and female: Face punctate. Punctures coarser and running into striations below antennal sockets. Face with a median smooth area. Face of male more regularly punctate and convex. Flagellar segments 6 to 11 in the male with tyloids. Mesoscutum punctate, punctures a little smaller and shallower than on mesopleurum. Scutellum flat to subconvex and shiny, with scattered punctures. Mesopleurum strongly punctate, but punctures not coarse or alveolar (as in *aethiops*), interspaces shiny and equal to the diameter of punctures. Punctures sometimes closer or contiguous at places. Metapleurum rugoso-striate anterodorsally and striate posteroventrally. Striations extending on the expanded and rather wide submetapleural ridge. Mesopleural suture below the mesopleural pit with well separated 10-13 transverse ridges. Propodeum rugose to rugoso-reticulate, its extreme base with two small median carinae, its apical region not smooth. First tergite sharply angled medially, with two small humps. Postpetiole and second and third tergites

rather coarsely punctate. Central part of fifth tergite with well formed punctures. Apices of all tergites smooth and shiny. Hind coxa punctate. Fourth segment of fore tarsus deeply notched apically. Nervulus interstitial or a little distad of basal vein. Male with first tergite flatter and thoracic sculpture a little weaker. Smaller sized specimens with weaker sculpture.

Black. Body pubescence whitish or light brown. Wing bases and their sclerites yellow. Tegula black or brownish-black. Legs black. Fore tibia yellowish anteriorly. Sometimes fore and middle femora yellow apically and their tibiae and tarsi brownish to brownish black. Hind tibia sometimes with a faint suggestion of sub-basal light colored spot or band. In male scutellum with a yellow spot. Tegula yellow with a black apical spot. Fore and middle femora, tibiae and tarsi often partly to largely reddish-brown to yellowish-brown.

Length: 15-20 mm. Fore wing 11-14 mm. Sometimes the male smaller.

Specimens: Japan: 1♀, July 1908, Gypsy Moth Lab., No. 1650, *ex Lymantria dispar*, det. by Viereck as "*Pimpla pluto* Ashm." (Hamden). Japan: Sapporo, 1♀ (homotype of *Pimpla luctuosa* by Townes), T. Uchida (Townes). Japan: Yokohama, 1♂ (homotype of *Pimpla aethiops neustriiae* Uchida by Townes), May 20, 1933 (Townes). In addition, a few males and females from Fukien, China and Japan seen in the Townes collection.

Distribution: Japan, Korea, China, Sakhalin, and Eastern USSR.

This species is related to *Coccygomimus pluto* (Ashmead) and *C. aethiops* (Curtis). *C. aethiops* has densely punctate abdominal tergites and mesopleurum, the punctures on mesopleurum touching each other and becoming alveolar. The body is dull. The first tergite is without dorsal humps. The fourth tarsal segment of fore leg is bilobed, but not deeply notched. *C. pluto* differs from *luctuosus* in having the wing bases and tegula black. The scutellum of male is black. Only 6-7th flagellar segments in the male have tyloids. The body sculpture is a little sparser, with punctures on face less dense, on mesopleurum well separated, shallower, and on tergite 5 not well formed and shallow. It is also smaller in size, about 12-14 mm. long and with brownish-black pubescence, though in male the pubescence is yellowish.

7. COCCYGOMIMUS SPURIUS (Gravenhorst) (Fig. 125)

Pimpla spuria Gravenhorst, 1829. Ichneumonologia Europaea, 3: 179. Europe.

Pimpla spuria: Yafaeva, 1959. Ukrainskaya Akad. Selsk. Nauk, p. 227. Ukrainian SSR. Host: *Lymantria dispar*.

Coccygomimus spurius: Townes and Townes, 1960. Bull. U. S. Natl. Mus., 216(2): 338.

Coccygomimus spurius has only recently been recorded as a parasite of the gypsy moth by Yafaeva (1959) from Ukraine, Russia. Kasparyan (1974), however, does not list that reference, nor that host. He records this species as a usual parasite of *Cydia (Cydia) pomonella*, distributed in Iran, Central and Southern Europe, Soviet Central Asia, and Caucasus, etc. Aubert (1969) lists several common hosts belonging to various families of Lepidoptera and also Coleoptera: Tenebrionidae. No reared specimen has been seen. The following description is based upon specimens seen in the Townes Collection.

Male and female: Male flagellum without tyloids. Face a little convex, shiny, with scattered but distinctly formed punctures. Frons shallowly excavated, minutely punctate, shiny and trans-striate centrally. Ocellar diameter about equal to ocellocular distance. Interocellar distance 1.2 the ocellocular

distance. Mesoscutum shiny, with minute scattered and shallow punctures. Mesopleurum shiny, with minute scattered punctures. Metapleurum shallowly punctate anteriorly and striato-rugose posteriorly. Propodeum punctato-rugose, its median carinae distinct in basal 0.3, its basal area smooth. Coxae not punctate, mat. Fourth tarsal segment of fore leg not deeply notched. Nervulus interstitial or a little distad of basal vein. First tergite flat in apical half, without humps. Abdominal tergites punctate, punctures well formed and interspaces shiny. Postpetiole punctate. Apical two tergites smoother. Apices of all tergites smooth and shiny. All epipleura wide.

Black. Body pubescence white or a little yellowish. Tegula black. Middle and hind coxae reddish or orange-brown. Fore coxa and trochanters blackish-brown. Fore and middle legs otherwise and hind trochanters and femur orange-brown. Hind femur without any fuscous mark. Hind tibia brownish, without a pale band or with an indistinct pale band, the margins of which are indistinct. Hind tibial color variable, sometimes entirely red or reddish-brown. Hind tarsus blackish.

In male the coloration is somewhat different. All coxae are black, first trochanters blackish, hind tibia black with a pale sub-basal band, and hind tarsus black. Tegula brownish-yellow. Apical margins of abdominal tergites subpolished.

Length: Male, 5-8 mm, female, 8-10 mm. Fore wing 4 to 7 mm.

Specimens: Several males and females from Ireland, Scotland, Germany, Russia and Rumania in the Townes Collection. 1♀, Debreczen, Hungary, 1923, R. T. Webber, Gypsy Moth Lab., but without any host label (Hamden).

This species is very close to *C. contemplator* (Mueller) in sculpture and general coloration. Both belong to the Aequalis species Group of Townes and Townes. The latter species, however, can be differentiated by having the fourth tarsal segment of fore leg apically deeply notched, first two flagellar segments shorter, less than or just equal to the longitudinal diameter of eye, and ovipositor sheath equal to or a little shorter than the hind tibia. The male of *C. spurius* has the basal half of 6th tergite coarsely punctate, while in the male of *contemplator* the 6th tergite is almost impunctate, mat.

Coccygomimus spurius also is close to *C. melanacrias* (Perkins), the latter having a distinct white annulus on hind tibia, and apex of hind tibia fuscous. *C. nipponicus* (Uchida) and *C. confinis* (Kasparyan) from Eastern Palaearctic are also related to *spurius* and *contemplator*, but they have black coxae.

2. Genus ITOPLECTIS (Fig. 2, 126, 127)

Itoptectis Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 164.

For synonymy and relationships with other Ephialtini, refer to Townes (1969).

Small to medium sized ichneumonids with fore wing 2.5 to 12.5 mm. long. Clypeus without a transverse suture. Mandible not narrowed apically, teeth equal to subequal. Occipital and prepectal carinae present. Inner margin of eye rather strongly concave at antennal socket. Mesopleural suture without a distinct angulation in the middle. Front tarsal claws of female with a basal tooth, the middle and hind tarsal claws of female and all tarsal claws of male simple. Nervellus intercepted far above the middle. Ovipositor straight.

Face and orbits of both sexes entirely black (cf. *Ephialtes*). Hind tibia banded (except in *viduata*) with apical and basal dark bands and a median pale

band.

Members of the genus *Itopectis* are widely distributed. They usually are internal parasites of lepidopterous pupae, but some (e.g. *I. conquisitor* and others) are often secondary parasites of Ichneumonidae, while others may be normally secondary parasites.

Unlike *Coccygomimus* and *Ephialtes*, most species of *Itopectis* do not give off a strong odor when captured or disturbed.

Five taxa of *Itopectis* have been reported as parasitic on the gypsy moth, viz., *I. alternans alternans* (Gravenhorst), *alternans spectabilis* (Matsumura), *conquisitor* (Say), *maculator maculator* (Fabricius), and *viduata* (Gravenhorst). Another species, *I. clavicornis* is here recorded from the gypsy moth. Some of them, including *I. clavicornis*, are also hyperparasites of Ichneumonidae associated with the gypsy moth.

Itopectis alternans spectabilis (Matsumura) (= *Exeristesoides spectabilis*) was first reported from *Lymantria dispar* in Japan by Fukaya (1936). It is also a hyperparasite of *Hyposoter takagii*, and some other ichneumonids and braconids (Townes *et al.* 1965). *I. alternans alternans* (Gravenhorst) is a European parasite of *Lymantria monacha*, which Oehlke (1967) reported from *L. dispar* rather than from *L. monacha*.

Itopectis conquisitor (Say) (= *Pimpla conquisitor*) was observed by Howard and Fiske (1911) to frequently attack gypsy moth pupae in the U.S.A., but the development of the parasite was rather infrequent. "*Pimpla tenuicornis* Cresson", recorded as a parasite of gypsy moth pupae, by Forbush and Fernald, but never reared at the laboratory, was believed by Howard and Fiske to be *Itopectis conquisitor*.

Itopectis maculator maculator (Fabricius) was reported as a parasite of *Lymantria dispar* by Oehlke (1967) from Europe. However, I could not trace it back to its original record and did not see it mentioned in other publications.

Itopectis viduata (Gravenhorst) (= *Pimpla viduata*) was reported as a parasite of *Lymantria dispar* by Meyer (1929).

Useful taxonomic and biological information on *Itopectis* can be found in Townes and Townes (1960), Šedivý (1963), Townes, Momoi and Townes (1965), Oehlke (1967), Aubert (1969), Kasparyan (1973) and Carlson (1979).

KEY TO THE SPECIES OF *ITOPLECTIS* ASSOCIATED WITH THE GYPSY MOTH

1. Hind tibia uniformly reddish-brown (sometimes with a faint suggestion of a yellow subbasal band, not sharply demarcated). Coxae and basal trochanteral segments black. Tarsal segments generally pale brownish, not clearly black marked. Europe, North America, USSR, and China.
 5. *viduata* (Gravenhorst)
 Hind tibia with a white or yellow subbasal band. Coxae reddish brown to black. 2
2. Antennal flagellum thickened apically, the subapical segments transverse. Ovipositor sheath short, about as long as the first tergite. Fore and middle legs largely yellow in male and yellowish-brown in female. Eurasia. 4. *clavicornis* (Thomson)
- Antennal flagellum not thickened apically, sometimes only slightly wider, but segments elongate rather than transverse. Ovipositor sheath considerably longer than tergite 1. 3

3. Mesopleurum with dense punctures. In male punctures smaller. All coxae and basal trochanteral segments black in male and female. Abdominal tergites usually reddish-brown laterally, sometimes apically also. Eurasia. 3. maculator (Fabricius)
 Mesopleurum finely punctate. Coxae and trochanters reddish-brown except in male of alternans where hind coxa black. Abdominal tergites narrowly yellow apically, or not so. Sides of tergites not reddish or yellow. . 4
4. Ovipositor sheath long, about 2.0-2.2 times the length of first tergite and 1.5 times the length of hind femur. Hind femur with a fuscous black apical mark. Punctures on abdominal tergites uniform, regular but on tergites 4-5 of male rather sparse. Pale bands on tergites rather conspicuous. North America. 1. conquisitor (Say)
 Ovipositor sheaths shorter, about 1.5-1.7 as long as the first tergite and 1.1-1.2 as long as the hind femur. Hind femur without a fuscous apical mark. Pale bands on tergites faint to inconspicuous. Tergites coarsely punctate. 2. alternans. . 5
5. Trochanters reddish-brown in female and yellow in male. Fore and middle legs reddish-brown in female and yellow in male. Basal black mark on hind tibia wider so that the yellow band is narrow. Apical half of hind tibia often reddish-brown rather than black. Eurasia.
 2a. alternans alternans (Gravenhorst)
 Trochanters reddish with yellow markings. Fore and middle legs largely yellow or yellowish-brown. Basal black mark on hind tibia very small, so that the yellow band is wide. Apical half of hind tibia black. Japan and Far east. 2b. alternans spectabilis (Matsumura)

1. ITOPLECTIS CONQUISITOR (Say) (Figs. 38, 40, 42, 127)

Cryptus conquisitor Say, 1936. Boston J. Nat. Hist., 1: 232.

Pimpla conquisitor: Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 138, 237.

Itoplectis conquisitor: Townes and Townes, 1960, U. S. Natl. Mus. Bull., 216(2): 287.

Itoplectis conquisitor: Campbell, 1963. Canad. Ent., 95: 337.

Itoplectis conquisitor: Carlson, 1979. In Krombein, *et al.* Catalog of Hymenoptera in America north of Mexico, 1: 340.

Useful taxonomical and biological references are given in Townes and Townes (1960) and Carlson (1979). Information pertaining to the association of this parasite with the gypsy moth is given by Howard and Fiske (1911) and Campbell (1963).

Male and female: Flagellum weakly widened apically. Temple receding from eye. Face moderately wide, punctate. Mesoscutum and mesopleurum with scattered small punctures. Notauli absent. Propodeum short, its medium carinae extending up to 0.3 its length. Fore tarsal claw of female with a large, broad tooth. Third tergite about as long as wide in male and 0.5 to 0.6 as long as wide in female. Fourth and fifth tergites of male polished and with widely separated punctures. In females punctures dense. Tergites 2-7 with weak depressions and elevations. Ovipositor sheath about 2.2 as long as the first tergite.

Black. Palpi of male white. Maxillary palpus of female white. Labial palpus of female light brown. Scape and pedicel of male antenna white in front. Flagellum reddish-brown beneath, more extensively so in male. Tegula and hind corner of pronotum white. Legs of female largely reddish-brown. Fore coxa blackish basally. Fore tibia and tarsus with faint yellow patches. Middle tibia with a pale subbasal band. Middle tarsal segment yellowish basally and fuscous apically. Apex of hind femur, base and apical 0.4 of hind tibia and apical half of hind tarsal segments black. Fourth tarsal segment wholly black. Hind tibia with a broad yellowish-white subbasal band. Hind tarsal segments whitish in basal half. In male, fore and middle legs largely yellow with tibiae yellowish-brown. Hind leg color same as in the female. Apices of abdominal tergites yellow.

Length: 9-14 mm. Fore wing 6.0-2.5 mm. Some specimens are rather short, 5-6 mm. long.

Specimens: Several males and females from different states of U.S.A., in Townes Collections. No reared specimens from the gypsy moth seen.

This species is readily distinguished by the color pattern of its legs and abdomen. The hind leg and abdomen gives a banded appearance. The sculpture of the fourth and fifth tergites of male is characteristic.

Itoplectis conquisitor is a polyphagous parasite and is hyperparasitic upon occasions. It is widely distributed in the Nearctic Region. Howard and Fiske (1911) observed that this parasite frequently attacked the gypsy moth pupae, but that the young larvae of it rarely completed their development upon it. Campbell (1963) substantiated those findings. He observed that *Itoplectis conquisitor* stung a number of prepupae and pupae of gypsy moth in the field, but hardly ever developed upon them. The species preferred to hunt in the open and exhibited a striking positive response to defoliated areas. In the Glenville area, it was the dominant species attacking gypsy moth pupae and prepupae. Adults occurred from early spring to late fall. A wide variety of exposed or weakly protected lepidopterous pupae or prepupae served as hosts. Development from egg to adult took about 20 days.

Itoplectis conquisitor apparently attacks the gypsy moth pupae and prepupae for getting food, rather than oviposition. However, in this process they puncture the pupal skin and kill the host. Sarcophagids oviposit in such pupae. They have a scavenger relationship with the host.

This species therefore kills pupae of the gypsy moth in large numbers. Three other native Ichneumonids, *Coccygomimus pedalis*, *Theronia atalantae* and *Theronia hilaris* have also been observed to kill more pupae than they parasitize, thus exerting a greater influence on the populations of gypsy moth than is usually credited to the Ichneumonidae.

Further information on its biology and biological references are given by Townes (1940) and Townes and Townes (1960).

2a. ITOPLECTIS ALTERNANS ALTERNANS (Gravenhorst) (Figs. 12, 30, 36, 37, 39, 126)

Pimpla alternans Gravenhorst, 1829. Ichneumonologia Europaea, 3: 201. Europe.

Itoplectis alternans: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 38. Hosts and distributional records in Eastern Palaearctic Region.

Itoplectis alternans: Oehlke, 1967. Hymenopterorum Catalogus (nova editio), 2(1): 26. Palaearctic. Various hosts including *Lymantria dispar*

Oehlke (1967) provides some biological references. Kasparyan (1973) provides a key to the Eurasian species of *Itopectis*.

This subspecies is extremely close to *Itopectis conquisitor* from North America, differing mainly as follows:

Mesopleural punctures sparser and minute. Propodeal carinae short and widely diverging. Propodeum smoother. Abdominal punctures coarse and contiguous in both the sexes. Ovipositor short, its sheaths 1.5 to 1.7 as long as the first tergite and about 1.1 to 1.2 as long as the hind femur.

Hind corner of pronotum very narrowly yellow, mainly in the region of postspiracular sclerite. Palpi yellowish-brown. Fore coxa usually reddish-brown. Hind femur without an apical fuscous mark. Apex of hind tibia reddish-brown. Abdominal tergites with faint to rather narrow brownish margins.

Length: 5-7 mm. Fore wing 4-6 mm.

Specimens: Italy: Portici, 1♂, 4♀, 1912, ex *Hyposoter disparis* Vier. [= *Phobocampe uncinata*], Gypsy Moth Lab., No. 7429F and 7429 (Hamden). Hungary: Olasziszka, 1♂, June 25, 1927, ex *Lymantria dispar*, labelled *Ephialtes (Itopectis)* sp. (Hamden). Several unrealed ♂, ♀ from Europe (Townes Coll.).

The above specimens reared at the Gypsy Moth Laboratory, indicate that it is a primary parasite of the gypsy moth, as well as a hyperparasite of a gypsy moth parasite, *Phobocampe uncinata*. In literature (Townes *et al.*, 1965, Aubert, 1969, etc.) it is reported as a parasite of several other Lepidoptera including *L. monacha*, and as a hyperparasite of *Rhogas*, *Casinarina* and *Hyposoter* species.

2b. ITOPLECTIS ALTERNANS SPECTABILIS (Matsumura)

Pimpla (Pimpla) spectabilis Matsumura, 1926. J. Coll. Agr. Hokkaido Imp. Univ., 18: 30. Japan. Host: *Dendrolimus spectabilis*.

Exeristesoides spectabilis: Fukaya, 1936. Oyo Dobutsugaku Zasshi, 8: 232, 335. Japan. Host: *Lymantria dispar*.

Itopectis alternans spectabilis: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 38. China, Japan, Korea. Several hosts in Japan.

This subspecies is close to *Itopectis conquisitor* and differs from the latter as given in the key and under *I. alternans alternans*. It differs from the subspecies *alternans* in having a rather broad yellowish-white band on hind tibia, with the basal black mark small to almost obliterated and apical black mark prominent. The fore and middle legs are lighter in color. In males they are largely yellow.

Length: 5-7 mm. Fore wing 4-5 mm.

Specimens examined: Japan: 2♂, 4♀, reared from *Grapholitha molesta* (Townes Coll.). No specimens reared from gypsy moth seen. It has been reported as a hyperparasite of *Hyposoter takagii*, *Eriborus molestae*, and *Apanteles* sp. in Japan.

3. ITOPLECTIS MACULATOR MACULATOR (Fabricius) (Fig. 2)

Ichneumon maculator Fabricius, 1775. Systema Entomologiae, p. 337. Germany.

Itopectis maculator: Townes, Momoi and Townes, 1965. Mem. Amer.

Ent. Inst., 5: 40. Eurasia, North America, North Africa.

Synonymical references and host records.

Itoplectis maculator maculator: Oehlke, 1967. Hymenopterorum Catalogus (nova editio), 2 (1): 28. Host: *Lymantria dispar*, besides several other hosts.

This species conforms in general to the description of *I. conquisitor* and is differentiated as follows:

Thorax rather closely punctate. Mesoscutum with small close punctures. Mesopleurum with dense well formed punctures, which are of moderate size and depth. In males punctures smaller. Propodeum densely punctate laterally, smoother medially, its median carinae extending in basal 0.25 and weakly diverging apically. Punctures on abdominal tergites dense and coalescing.

Coxae and first trochanteral segments of all legs black. Fore and middle legs yellowish-brown, with yellow patches. Hind leg brownish-yellow or orange colored, with tibia having a yellow sub-basal band and tarsal segments basally yellow. Abdominal tergites laterally brownish. Their apices also brownish. Extent of lateral brownish marks on tergites variable, sometimes tergites more extensively brownish-yellow, particularly in males.

Length: 5-10 mm. Fore wing 4 to 7.5 mm.

Specimens: Spain: Madrid, 1♂, June 1925, *Lymantria dispar*, Gypsy Moth Lab. Italy: Portici, 1♀, 1912, ex *Hyposoter disparis* Vier. [= *Phobocampe uncinata*], Gypsy Moth Lab., No. 7429e. 1♀, "bred from *P. dispar*", Gypsy Moth Lab., No. 1094, July 15, labelled "*Scambus maculatus* F. (All Hamden).

Distribution: Eurasia, N. Africa, and N. America. Walkley (1958) recorded its establishment in North America in Oregon. See Townes and Townes (1960) and Carlson (1979) for further information about its establishment in the U.S.A., and for biological references.

Šedivý (1963) provided a list of hosts in Europe and Meyer (1934) in USSR.

The above mentioned specimens indicate its occurrence at times as parasitic on *Lymantria dispar*, and that it is hyperparasitic on occasion. Vasic (1958) reported that it parasitized 25% of *Casinarina tenuiventris* cocoons in Yugoslavia.

4. ITOPLECTIS CLAVICORNIS (Thomson)

Pimpla clavicornis Thomson, 1889. Opusc. Ent., 13: 1409. Europe.

Itoplectis clavicornis: Oehlke, 1967. Hymenopterorum Catalogus (nova editio), 2(1): 27. Europe. England.

According to Townes and Townes (1960) *I. clavicornis* is usually a secondary parasite on Ichneumonidae. It is a rather distinct species with flagellum thickened apically, the subapical segments being wider than long. Ovipositor short. Ovipositor sheaths about as long as the first tergite. Mesopleurum smoother, polished. Median propodeal carinae short. Abdomen slender, punctate.

Legs in general yellowish-brown with hind femur orange colored and without any apical fuscous mark. Hind tibia with a broad yellow sub-basal band. Fore and middle legs in male more yellow. Hind coxa of male black and that of female brown to partly blackish. Abdominal tergites without conspicuous pale bands.

Length: 8-9 mm. Fore wing 5-6 mm.

Specimens: Italy: Portici, 1912, 1♂, 1♀, *ex Hyposoter dispar* Vier. [=Phobocampe uncinata], Gypsy Moth Lab., No. 5427 and 7435 DA. Hungary: Vees, 3♂, May 13, 1929, *ex Hyposoter dispar*, Gypsy Moth Lab., No. 13039 D (Hamden).

Distribution: Europe.

The above specimens attest to the fact that *I. clavicornis* is a hyperparasite of *Phobocampe uncinata* and not useful in the control of the gypsy moth.

5. ITOPLECTIS VIDUATA (Gravenhorst)

Pimpla viduata Gravenhorst, 1829. Ichneumonologia Europaea, 3: 214. Europe.

Pimpla viduata: Meyer, 1929. Izv. Otd. Prikl. Ent. GIOA (Repts. Bur. Appl. Ent.), 4: 235, 240. USSR. Hosts: *Lymantria dispar* and *Cosmia subtilis*.

Itoplectis viduata: Townes and Townes, 1960. U. S. Natl. Mus. Bull., 216(2): 293. China: Manchuria, Europe, N. America. Various hosts in North America.

This species is readily distinguished from all other species of *Itoplectis* by its hind tibia being uniformly reddish-brown and all coxae and first trochanteral segments black. Middle and hind coxae are not mentioned to be black in European specimens by Kasparyan (1973).

It is somewhat robust species with deeper punctation on mesoscutum and mesopleurum, propodeal spiracles elongate-oval (usually short oval), propodeum punctate laterally, its median carinae extending up to the middle, abdominal tergites strongly punctate, and ovipositor sheath about 2.5 as long as the first tergite.

All legs uniformly orange to reddish-brown, with their coxae and trochanters black (Nearctic specimens seen). Abdomen without yellow bands.

Length: 9-12 mm. Fore wing 7.5 to 11.5 mm.

Specimens: 3♂, 3♀, from California, Colorado and Arizona in Townes Collection. No reared specimens seen.

Distribution: Widely distributed in Europe, USSR and western North America.

Hosts: Recorded as a parasite of *Lymantria dispar* by Meyer (1929). Townes and Townes (1960) list several hosts in North America. Aubert (1969) lists European hosts.

3. Genus EPHIALTES (Figs. 3, 128, 129)

Ephialtes Schrank, 1802. Fauna Boica, 2: 316.

This genus has often been called *Apechthis*. Refer to Townes (1969) for synonymy and its relationships with other members of the tribe Ephialtini, subfamily Pimplinae.

Ephialtes can easily be distinguished from other pimpline ichneumonids by its sharply decurved ovipositor tip. It is further characterized by having the face of the male largely to entirely white or yellow. Orbit of female narrowly whitish in front. Inner margin of eye rather strongly concave opposite antennal sockets. Malar space 0.15 to 0.2 the basal width of mandible. Clypeus normally formed, basally a little concave, without any transverse suture. Mandible broad, teeth subequal. Notauli weak or absent. Propodeum with only

median carinae extending in basal 0.5 to 0.7. Fore, middle and sometimes the hind tarsal claws of female with a large tooth. Tarsal claws without an enlarged flat-tipped hair. Nervellus intercepted well above the middle. Abdomen with coarse punctures. Epipleurum of fifth tergite narrow, at least 3.0 as long as wide in female and 4.0 in male.

Members of the genus *Ephialtes* are medium-sized to moderately large ichneumon-flies. They are internal parasites of lepidopterous prepupae or pupae.

Three species have been reported in literature as being parasitic upon *Lymantria dispar*. These are *Ephialtes compunctor* (L.) (= *brassicariae*), *E. rufatus* (Gmelin) (= *rufata* Gravenhorst), and *E. capulifera* (Kriechbaumer). They have not been commonly encountered, however.

Howard and Fiske (1911) reported rearing *Ephialtes compunctor* (L.) (as *Pimpla brassicariae* Poda) at the Gypsy Moth Laboratory (Massachusetts) infrequently from the European collections of the gypsy moth and the brown tail moth. Rudow (1911) mentioned *Pimpla varicornis* Gr. = *compunctor* (L.) as a parasite of gypsy moth and the nun moth. Stadler (1933) mentioned it (= *P. brassicariae*) as a parasite of *Lymantria dispar* in Europe.

Rudow (1911) reported *Ephialtes rufatus* (Gmelin) (= *Pimpla rufata* Grav.) as a parasite of *Lymantria dispar* and *L. monacha* in Europe. Meyer (1927) reported it from the gypsy moth in Russia. However, he did not mention this host in his subsequent publications on USSR Ichneumonidae (Meyer, 1934, 1936). Thompson's source was Meyer (1927) (RAE, A, 16: 200).

Ephialtes capulifera (Kriechbaumer) was first reported as a parasite of *Lymantria dispar* by Uchida (1958) (as *Apechthis capulifera* var. *nigriabdominalis*) in Japan. Kamijo (1962) gave some biological notes.

All these three species have been frequently mentioned as parasites of *Lymantria monacha* as well as several other hosts in Europe and Japan. Aubert (1969) and Townes *et al.* (1965) may be consulted for listings of hosts, taxonomic references and distributional records.

"*Pimpla dentator* Thomson" mentioned in literature as a parasite of *Lymantria monacha* is a lapsus for *Pimpla quadridentata* Thomson, which is a species of *Ephialtes*.

KEY TO THE SPECIES OF *EPHIALTES* PARASITIC UPON THE GYPSY MOTH

1. Hind coxa and apex of hind femur black. Usually all coxae black and hind femur black. Tibia black, with a wide pale submedian band. Body pubescence white. Eurasia and Far East.
 1. capulifera (Kriechbaumer)
 Hind coxa and hind femur usually wholly reddish. 2
2. Body pubescence brownish. Mesoscutum without yellow markings, except sometimes in males. Scutellum narrowly yellow apically. Metascutellum black. First tergite with two conical projections in the middle. Hind tibia without any pale band, rust-red colored (except faintly so in a subspecies, *orientalis*, from Eastern Siberia). . . . 2. compunctor (L.)

Body pubescence whitish. Mesoscutum with two stripes beyond its middle and usually also along its basolateral corners. Scutellum largely yellow. Metascutellum yellow. First tergite without conical projections, only convexly angled medially. Hind tibia with a faint to somewhat distinct

white band. 3. rufatus (Gmelin)

1. EPHIALTES CAPULIFERA (Kriechbaumer)

Pimpla destructor Smith, 1874. Trans. Ent. Soc. London, 1874: 394.

Japan. Name preoccupied by Smith, 1863.

Pimpla capulifera Kriechbaumer, 1887. Ent. Nachr., 13: 119. Germany.

Apechthis capulifera var. *nigriorbitalis* Uchida, 1958. Shin Konchu, 8(5): 8. Japan. Hosts: *Lymantria dispar* and others.

Apechthis capulifera: Kamijo, 1962. Kôshunai Rinboku Ikushujo Hokoku, 1: 87. biol. Japan. Host: *Lymantria dispar*.

Male and female: Face a little longer than wide, with scattered punctures, wrinkled in a median area below antennal sockets. Clypeus basally a little convex and with scattered punctures, its apical 0.75 flat and somewhat mat. Malar space 0.2 the basal width of mandible. Frons and vertex smooth. Inter-ocellar distance 1.7 to 1.8 the ocellocular distance. Vertex narrow, sharply receding from behind ocelli. Mesoscutum dull mat, leathery in texture. Scutellum subpolished with scattered minute punctures. Pronotum polished, with scattered minute punctures along its upper margin. Mesopleurum polished and with scattered punctures, speculum glabrous. Metapleurum polished with minute punctures in its upper 0.3. In larger specimens the punctures a little spread out on side of thorax. Propodeal spiracle oval, small. Propodeum finely rugoso-punctate except the petiolar area which is smooth. Median propodeal carinae a little diverging apically and ending in the middle of propodeum. Area between the carinae smooth. Areolet more trapezoidal with first intercubitus shorter than the second and second recurrent in the apical 0.3. Abdomen closely punctate. First tergite with coarser shallow punctures, tending to be shallowly rugoso-punctate. Its median dorsal carinae forming moderately convex humps, broadly angulate in the female and evenly rounded in the male. Ovipositor sharply decurved, though not quite angled or L-shaped, more sigmoid.

Black. Flagellum black or yellowish-brown ventrally and darker dorsally. Face narrowly yellow along inner orbits and sometimes on vertical orbits. Palpi and tegula brown. Scutellum and metascutellum apically yellow. Coxae wholly to largely black. Legs otherwise yellowish-brown with yellow patches on fore femur, tibia and tarsus, middle tibia and tarsus, and apex of middle femur. Hind tibia with a broad yellow sub-basal band. Apex of hind femur, tibia except for the yellow band, and hind tarsus black to blackish-brown. Stigma and veins brownish-black. Body pubescence white.

In many specimens from Japan (var. *sapporoensis*) the legs are more extensively black, with hind femur wholly black and black marks on trochanters and middle femur. The tegula is also blackish. In some other specimens the coxae are partly black and partly yellow, and yellow on hind tibia more extensive. The face is more extensively yellow on sides. The scutellum and metascutellum are also yellow. A few specimens, usually the males have the legs extensively yellow. A female from Hungary from gypsy moth has all femora orange colored and all coxae black.

Length: 12-18 mm. Fore wing 10-13 mm.

Specimens: Hungary: Baja, 1♀, ex *Lymantria dispar*, "Gypsy Moth Lab., No. 3483C". (labelled as *Apechthis* sp 1) (Hamden). Japan: Hokkaido, Higashimokoto, 1♀, July 24, 1978, ex pupa of *Lymantria dispar*, P. Schaefer

(BIRL, Delaware). Hokkaido, Jyozonkei, 1♀, July 21, 1975, emerged from pupa of *Lymantria dispar*, August 4, 1975, P. Schaefer (BIRL, Delaware). Several ♂♀ from Japan (Townes Coll.).

Distribution: Eurasia, Japan, Korea, Taiwan and China. According to Kasparyan (1973) it is a transpalaeartic forest species, which is of rather rare occurrence in the European part of USSR.

Hosts: *Lymantria dispar*, *L. monacha* and several other hosts belonging to the following families (cf. Aubert, 1969): Tortricidae, Geometridae, Lasiocampidae, Arctiidae, Lymantriidae, Noctuidae, Hesperidae, Papilionidae, Pierididae, Nymphalidae, and Cerambycidae.

2. EPHIALTES COMPUNCTOR (Linnaeus) (Figs. 3, 128)

Ichneumon compunctor Linnaeus, 1758. Systema Naturae, (Ed. 10) 1: 564. Europe.

Ichneumon brassicariae Poda, 1761. Insecta Musei Graecensis, p. 105. Yugoslavia. Host: *Pieris brassicariae*.

Pimpla (Apechthis) brassicariae: Howard and Fiske, 1911. U. S. Dept. Agri. Bur. Ent. Bull., 91: 85, 238. Host: *Lymantria dispar*.

Ephialtes compunctor: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 44. References.

Male and female: Essentially similar in sculpture to *E. capulifera* and differing as follows:

Metapleurum largely smooth and polished. First tergite convex and dorsally humped, with its median carinae angled in the middle, the area between them depressed. Fifth tergite shallowly punctate with interspaces shiny. Side of thorax more polished. Propodeum basally smoother. Median propodeal carinae longer, extending up to basal 0.4 to 0.5 and widely diverging. Areolet more triangular, with second recurrent vein near its middle. Ovipositor tip strongly decurved, almost L-shaped.

Black. Flagellum yellowish-brown. Palpi and tegula blackish-brown. Scutellum yellow near metascutellum. Metascutellum black or only faintly yellow-marked. Mesoscutum as a rule without yellow markings, yellow markings only sometimes present in males. Legs largely reddish-brown with fore coxa and base of middle coxa sometimes black. Hind tibia rust-red, usually without banding (except faintly so in *compunctor orientalis* Kasparyan). Hind tarsal segments fuscous apically. Body pubescence brownish.

Length: 12-16 mm. Fore wing 10-12 mm.

Specimens: France: Charroux, 1♀, bred from *Lymantria dispar*, Gypsy Moth Lab, No. 1683, det. as *Apechthis brassicariae* Poda, by Muesebeck. Germany, 1♂, bred from *Lymantria dispar*, Gypsy Moth Lab, No. 829 Ag 5 (Hamden). Several males and females from Europe in Townes Collection.

Distribution: Europe, Russia, Japan and Korea. Kasparyan (1973) described an Eastern Siberian subspecies, *E. compunctor orientalis*, with banded hind tibia.

Hosts: A polyphagous parasite developing within the pupae of several families of Lepidoptera and some Coleoptera (cf. Aubert, 1969), including *Lymantria dispar* and *L. monacha*. Townes, *et al.* (1965) give host records from Japan and Russia. Hedlund and Mihalache (1980) reared two specimens of *Ephialtes compunctor* from the gypsy moth from Site B in Southern Rumania, which they considered to be a new host record. According to them the parasitism was less than 1%. Vasic (1958) reported it from Yugoslavia from the gypsy moth.

3. *EPHIALTES RUFATUS* (Gmelin) (Fig. 129)

Ichneumon rufatus Gmelin, 1790. In Linnaeus: Systema Naturae, Ed 13 (1) 5: 2684. Europe.

Pimpla rufata: Gravenhorst, 1829. Ichneumonologia Europaea, 3: 164. Europe.

Pimpla rufata: Grav.: Rudow, 1911. Internatl. Ent. Ztschr., 5: 99. Europe. Hosts: *Lymantria monacha*, *L. dispar*.

Pimpla rufata: Meyer, 1927, Izv. Otd. Prikl. Ent. GIOA (Repts. Bur. Appl. Ent.), 3 (1): 75-91. Russia. Hosts: *Lymantria dispar*, *Aporia crataegi*, *Malacosoma neustria*, *Diprion pini*.

Ephialtes rufatus: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 45. Germany, Japan, Kamchatka, Korea, Kuriles, Russia, Sakhalin. Full synonymical references and hosts.

Further taxonomical and biological references are given by Oehlke (1967) and Aubert (1969), which may also be consulted for the various hosts.

Essentially similar in sculpture to *Ephialtes capulifera*, and differing as follows:

Malar space 0.25 the basal width of mandible. Metapleurum with scattered punctures. Propodeum smoother basally. Propodeal sculpture less coarse and somewhat shiny. Median propodeal carinae generally shorter, almost parallel-sided and ending in a central rugose area. Propodeal spiracles bean-shaped. Areolet more triangular in outline, with the two intercubiti almost equal and second recurrent vein meeting areolet close to its middle. First tergite not conspicuously humped medially. Abdominal tergites less closely punctate. Punctures on fourth and fifth tergites well separated with interspaces shiny. Ovipositor tip only slightly decurved.

Black. Face, frons and vertex with narrow yellow orbital lines. Flagellum yellowish-brown ventrally and blackish dorsally. Palpi and tegula orange-yellow. Mesoscutum with two yellow lines behind its middle. Sometimes its antero-lateral corners also yellow. Scutellum broadly and metascutellum almost wholly yellow. Legs, including coxae, reddish-brown, with yellow patches on fore trochanters, apex of femur, tibia and tarsus. Apex of middle femur, tibia and tarsus also with yellow marks. Hind tibia fuscous at extreme base and with a faint to rather distinct sub-basal yellow band. Hind basitarsus yellow except apically. Coxae partly black in Japanese populations (*rufatus geometriae*). Body pubescence whitish.

Length: 10-15 mm. Fore wing 8-12 mm.

Specimens: Several males and females, from Europe and Japan in Townes Collection. No reared specimens seen. The Japanese populations have the coxae black marked and yellow band on hind tibia more pronounced. Perhaps they do represent a distinct subspecies, *Ephialtes rufatus geometriae* Uchida, 1928. This has, however, been synonymized under the nominate subspecies (Townes *et al.*, 1965).

Distribution: Europe, Russia, Japan and Korea.

Hosts: *Lymantria dispar*, *L. monacha*, and several others belonging to various families of Lepidoptera (Townes, Momoi and Townes, 1965). Aubert (1969) records the hosts from Europe, including a few cases of parasitism of Diprionidae. Vasic (1958) reported it from the gypsy moth in Yugoslavia.

Tribe THERONIINI

Members of the tribe Theroniini are characterized by having the mesopleural suture angulate near middle, propodeum more or less areolated, areola often distinctly formed, tarsal claws simple, without a basal lobe, areolet present, subgenital plate of male often longer than wide, and ovipositor short to long, of uniform width.

Only one genus *Theronia* is associated with the gypsy moth. They are usually yellowish-brown in color (although some species are black) and have an enlarged hair on each tarsal claw which is flattened at the tip.

4. Genus THERONIA (Figs. 4, 132)

Theronia Holmgren, 1859. Öfvers. Svenska Vetensk. Akad. Forh., 16: 123.

Townes (1969) may be consulted for generic synonymy and key to distinguish it from other Theroniini.

Mandible not strongly tapered, its teeth equal. Clypeus truncate or with a median notch. Prepectal carina present. Mesopleural suture with a weak angulation near middle. Propodeal carinae strong. Tarsal claws very large, simple, but with an enlarged bristle arising sub-basally below and extending to apex of claw, the tip of the bristle with a spatulate enlargement. Nervellus intercepted far above the middle. Areolet present. Abdomen polished, with minute setiferous punctures. Ovipositor short to moderately long, cylindric, its sheath usually about 0.45 as long as the forewing.

Species of *Theronia* are medium-sized ichneumonids inhabiting mostly dense forests. They are pale colored and generally fly low. They are primary or secondary parasites within lepidopterous pupae. Some species parasitize pupae of aculeate wasps in their nests. The egg is deposited within the prepupa or a freshly formed pupa and emergence is from the pupa. As a primary parasite the insect lives within its host. If the host attacked has already been attacked by another ichneumonid, it becomes a secondary parasite external to the latter. The larvae of *Theronia* have a large internal tooth on the mandible.

Two species, *Theronia atalantae* (and its subspecies) and *T. hilaris* (= *melanocephala*) have been associated with gypsy moth. *T. atalantae* has been commonly reared from the gypsy moth in Europe, USSR, North America, and Japan. A subspecies of it occurs on *Lymantria obfuscata* in India. *T. zebra diluta* was reported from *Lymantria serva* in Taiwan by Gupta (1962).

T. atalantae and *T. hilaris* have been reported as hyperparasitic on other ichneumonids associated with the gypsy moth on occasions.

KEY TO THE SPECIES AND SUBSPECIES OF THERONIA
ASSOCIATED WITH THE GYPSY MOTH

1. Hind femur sharp beneath for part of its length, and usually with a weak to sharply irregularly serrate ridge. Head rufous-brown.
 1. atalantae 2
- Hind femur rounded beneath, without a ridge. Head black. (In other subspecies from Europe and Japan whole body black). North America.
 2. hilaris hilaris (Say)

2. Abdominal tergites with dark brown to black basal bands or spots. Flagellum brown. Thorax with extensive fuscous markings. Japan, Korea, Manchuria, and Siberia. 2c. *atalantae gestator* (Thunberg)
Abdominal tergites uniformly rufous brown, or rarely with a few spots. Thorax rufous brown or a few spots and stripes on mesopleurum, base of propodeum or around scutellum. 3
3. Wings dark brown. Flagellum blackish-brown to black. Ridge or crest along lower margin of hind femur weak. Mesopleurum and base of scutellum with fuscous markings. India: Kashmir and Himachal Pradesh. 1d. *atalantae himalayensis*, n. subsp.
Wings clear hyaline, or only lightly yellowish-tinged. Flagellum black to brown. Lower margin of hind femur usually with a serrated ridge. Fuscous marks on thorax absent or less extensive (except sometimes in *atalantae atalantae*). 4
4. Flagellum light brown, of the same color as the thorax. Mesopleurum often with fuscous markings. Sometimes mesoscutum also with fuscous markings. Europe. 1a. *atalantae atalantae* (Poda)
Flagellum dark brown, darker in color than the thorax. Mesopleurum partly to largely yellowish, usually without fuscous markings. North America. 1b. *atalantae fulvescens* (Cresson)

1. THERONIA ATALANTAE (Poda) (Figs. 4, 132)

Clypeus apically thin and only slightly concave. Prepectal carina roundly curved forward and almost reaching margin of pronotum. Notauli distinct at front end of mesoscutum. Scutellum not carinate laterally. Thorax shiny, with minute scattered setiferous punctures. Propodeal spiracle elongate, linear. Median and lateral propodeal carinae present. Median carinae parallel-sided and extending to middle of propodeum, where they meet the strongly curved apical transverse carina. Lateral carinae obsolete basally, opposite spiracles. Petiolar area hexagonal. Median section of apical transverse carina bounding the combined areola and basal area often dipped and notched in the middle in the female. Hind femur with a ventral crest or ridge, which is often serrate in larger specimens. First tergite about 1.5 as long as wide and with strong dorsal carinae. Abdomen polished. Ovipositor about 0.7-0.75 as long as the abdomen, its sheaths about 1.5 as long as the hind femur.

Rufous-brown. Wings hyaline or brown tinged. Thorax and abdomen with or without fuscous marks depending upon the subspecies.

Size variable, depending upon the host. Those reared from ichneumonid hosts much smaller than those reared from the gypsy moth.

1a. THERONIA ATALANTAE ATALANTAE (Poda) (Figs. 4, 24, 41, 132)

Ichneumon atalantae Poda, 1761. *Insecta Musei Graecensis*, p. 106.

Europe. Host: *Vanessa atalanta*.

Ichneumon flavicans Fabricius, 1793. *Ent. Syst.*, 2: 182. Germany.

Pimpla flavicans Fabr.: Ratzeburg, 1844: 118. Germany. Hosts: pupae of *Aporia crataegi*, *Dendrolimus pini*, and *Lymantria dispar*.

Theronia atalantae: Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 85, 236. Lab. reared from gypsy moth.

Theronia atalantae atalantae: Townes and Townes, 1960. U. S. Natl. Mus. Bull., 216(2): 354.

This subspecies has several synonyms in Europe. Refer to Townes, Momoi and Townes (1965) and Oehlke (1967) for synonymical references, and host records.

Ratzeburg (1844) first reported it from *Lymantria dispar* in Europe. Howard and Fiske reared it in the Gypsy Moth Laboratory from shipments of gypsy moth pupae from Europe. Several authors have recorded it as a parasite of the gypsy moth in Europe (Thompson, 1946). Some of the recent studies are of Györfi (1963), and Hedlund and Mihalache (1980).

Theronia atalantae atalantae is characterized by having the flagellum light brown in color (resembling the coloration of the thorax), mesopleurum brownish, mesoscutum and mesopleurum usually with only small fuscous marks, which at times may be extensive, or reduced, wings light yellowish-hyaline, and legs and abdomen pale yellowish-brown, without fuscous marks. The scutellum is yellow. Two females in Townes Collection from Germany and Poland have extensive fuscous marks on thorax, and hind coxae partly blackish.

Length: 8-13 mm. Fore wing 7-11 mm.

Specimens: Southern Rumania: Site B, 1♂, 1♀, July 1978, *ex Lymantria dispar* pupae, R. C. Hedlund (E.P.L., Paris). Hungary: Vees, 2♂, July 12, 1928, *ex Hyposoter* sp., Gypsy Moth Lab., Nos. 13039D and 13039B2. Hungary: Olaszliszka, 2♂, bred from *L. dispar*, Gypsy Moth Lab., No. 13028B. Italy, 1♂, July 22, 1911, bred from *L. dispar*, Gypsy Moth Lab., No. 3416. Italy, 1♂, June 1911, *ex Hyposoter disparis*, Gypsy Moth Lab., No. 3410B (all FIS, Hamden). Several males and females without host data, from Europe in Townes Collection.

Distribution: Widely distributed in Europe.

Hosts: Several hosts are recorded from Europe and USSR, including *Lymantris dispar* and *L. monacha*. It is also recorded as a hyperparasite of genera like *Casinaria*, *Iseropus*, *Rhogas*, etc. It is here recorded as a hyperparasite of *Phobocampe uncinata* (= *Hyposoter disparis*).

It is likely that many USSR records may pertain to *T. atalantae gestator*, which occurs in the Asian part of USSR.

It is a casual parasite of the pupae of *Lymantria dispar* and has never been reared in abundance on that host, although it is likely that it may be killing more host pupae by puncturing the pupae than by parasitizing, as has been seen in the U.S.A. by Campbell (1963) in *T. atalantae fulvescens*.

1b. THERONIA ATALANTAE FULVESCENS (Cresson) (Fig. 18)

Pimpla fulvescens Cresson, 1865. Proc. Ent. Soc. Philadelphia, 4: 268. U.S.A.: Colorado.

Theronia fulvescens: Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 137, 141, 142, 236-237. Hosts: *Lymantria dispar*, *Euproctis chrysorrhoea*.

Theronia atalantae fulvescens: Townes and Townes, 1960. U. S. Natl. Mus. Bull., 216(2): 354. Syn., distribution and biological references.

This subspecies was first mentioned by Howard and Fiske (1911) as a native North American parasite of the gypsy moth. According to them the record of *Theronia melanocephala* (Brullé) = *hilaris hilaris* (Say) of Forbush and Fernald (1896) pertained to this subspecies. They considered it a primary parasite of the gypsy moth. It has been also reared from *Itoplectis conquisitor* (Say), another primary parasite of the gypsy moth, which often fails to develop on that host. They believed it to be a case of superparasitism: the host pupa by chance containing larva of *Itoplectis* and *Theronia* parasitizing that pupa. *T. atalantae fulvescens* is parasitized by a chalcid, *Dibrachys cavus*.

Theronia atalantae fulvescens differs from the nominate subspecies by having the flagellum black to brownish-black, mesopleurum largely yellow, usually without fuscous markings, though in larger specimens sometimes present on prepectus near lower corner of pronotum, and wings hyaline, lightly tinged with yellow. Specimens from southwestern U.S.A. tend to have wings a little darker.

This subspecies is sometimes difficult to separate from *atalantae atalantae*, as coloration of the two often approach each other.

Length: 6-13 mm. Fore wing 4-11 mm.

Specimens: U.S.A.: Providence, R.I., 1♂, July 24, 1916, "ex tray of b.t. pupae", Gypsy Moth Lab., No. 12099. 2♂, August 6, 1907, Gypsy Moth Lab., No. 826-07 (Hamden). Perry Co., Pa., Millers Gap, *ex pupa*, 1♂, June 27, 1978, E. M. Blumenthal. Dauphin Co., Pa., Jackson Twp., July 6, 1977 (both these apparently reared from *Lymantria dispar*) (Pennsylvania).

Distribution: Widely distributed in North America. Schedl (1936) mentioned it as occurring in Japan, but that record should pertain to *T. atalantae gestator*.

Hosts: Several host records are given by Townes (1940) and Carlson (1979). Townes and Townes (1960) give several biological references.

Biological Notes: Howard and Fiske (1911) considered *Theronia atalantae fulvescens* as "the most common American parasite completing its transformation upon the gypsy moth" pupae. Parasitism at times amounted to 2 per cent. It appears that the adult female overwinters and that there is a single generation per year.

According to the observations of Campbell (1963), this species seeks its host under shady conditions, in forests and seldom is seen in the open, though at times it may be seen along the border of a defoliated area. About 25% of the pupae stung by the parasite produced ichneumonid offspring. None of the pupae stung were fed upon, but all prepupae stung were fed upon. The effectiveness of this parasite is both by parasitization as well as by killing the host pupae and prepupae through stinging.

Townes (1940) summarized the biological information on this species as follows:

"*Theronia atalantae* may be either a primary or a secondary parasite. If the host attacked has already been parasitized by another ichneumonid it becomes a secondary parasite, if not it lives as a primary. There is no clear evidence that it is obligated to be a secondary parasite on any host, although it has been shown usually to live thus in the case of *Malacosoma*. As a primary parasite the insect lives inside its host. When it is a secondary parasite, it lives inside its primary host and outside of its secondary host. The egg is deposited only in a prepupa or a freshly formed pupa. Fiske believes the egg stage to last about a day. He has observed that on the average the first three larval stages last two days each and the fourth stage feeds for two days and then spins its cocoon for one day and rests two days before forming

the pupa. After two to four days the pupa hatches. Development from the egg to the adult thus consumes fourteen to eighteen days. When a secondary parasite on *Malacoma americana* (through *Itoplectis conquisitor*) in New Hampshire, most of the adults emerged July 10-20, the females about four days behind the males. *Itoplectis conquisitor* emerged from the same cocoons on an average of seven days earlier than its parasite."

1c. THERONIA ATALANTAE GESTATOR (Thunberg)

Ichneumon gestator Thunberg, 1822. Mem. Acad. Imp. Sci. St.

Pétersbourg, 8: 262; 1824, 9: 312.

Theronia japonica Ashmead, 1906. Proc. U. S. Natl. Mus., 30: 181.

Japan.

Theronia japonica: Howard and Fiske, 1911. U. S. Dept. Agr. Bur.

Ent. Bull., 91: 121. Japan. Host: *Lymantria dispar*.

Theronia atalantae gestator: Townes, Momoi and Townes, 1965. Mem.

Amer. Ent. Inst., 5: 64. Synonymical and biological references.

Japan, Korea, China, USSR.

This subspecies is readily distinguished from the other subspecies of *atalantae* by having dark brown bands or spots on its abdomen, and the thorax also extensively dark marked. The wings are pale-hyaline, flagellum brown, hind coxa with a black or dark brown mark, and the hind femur is often fuscous ventrally.

The Japanese and the Korean populations of this subspecies are uniformly distinctive by the blackish markings, but populations from USSR and China tend to intergrade with *atalantae atalantae*. Rarely the American specimens approach *gestator* by having black markings on basal abdominal tergites or somewhat extensively on the thorax.

Length: 8-13 mm. Fore wing 5.5-11.5 mm.

Specimens: Japan: 4♂, 3♀, bred from *Lymantria dispar*, 1908, 1910, some without date, Gypsy Moth Lab., Nos. 1600, 1825, & 3399A (Hamden). 1♂, labelled 'Europe ex *L. dispar*, Istria Austria thru Ruhl, Gypsy Moth Lab. No. 853-07, Au. 12. 07.' (Hamden). Japan: Sekigahara, Honshu, 2♂, 1♀. ex pupa of *Lymantria dispar*, June 20, 1977, emerged July 6, 7 and 10, 1977, P. Schaefer (B.I.R.L., Delaware).

Distribution: Eastern Palaearctic Region, typically in Japan, Korea, North China, Siberia and adjacent areas. Occurrence in Europe (specimen from Austria above) is rather unusual, though it is reported to intergrade with *atalantae atalantae* in Europe.

This subspecies was first reported as a parasite of *Lymantria dispar* by Howard and Fiske (1911). Further references are given by Townes, Momoi and Townes (1965).

1d. THERONIA ATALANTAE HIMALAYENSIS, n. subsp.

(= *Theronia* sp., or *Theronia atalantae atalantae* from *Lymantria obfusca* from Kashmir)

Male and female: This subspecies is characterized by its brownish wings, black flagellum, and rufous brown body, with fuscous marks on antennal scrobes, prepectus, below subtegular ridge, base of scutellum, wing bases, lower half of mesopleural groove, and along groove separating metapleurum

from mesopleurum. The anterior margin of the middle lobe of mesoscutum rather vertically and conspicuously raised and prominently separated from the rest of mesoscutum. In profile view the front edge of mesoscutum appears concave and raised. Ventral margin of hind femur with a shorter ridge, inconspicuously serrated.

Length: 10-13 mm. Fore wing 9-11.5 mm.

Holotype: ♀, India: Manali, 1828 m., in Northwest Himalaya (Himachal Pradesh), May 29, 1970, Dauli Ram, Coll. No. K252 (Gupta). *Paratypes:* 25♀, same locality as the holotype, collected between May 17 to June 3, 1970 by various collectors (Gupta). Kashmir: Srinagar, 1♂, 1♀, July 1966, *ex* pupa of *Lymantria*, Gupta, No. 277; 1♀, June 1970, Gupta (Gupta). Srinagar, 4♂, 4♀, July 1963, C. I. B. C., Indian Station, *ex* pupae of *Lymantria obfusca* on willow (CIBC, Bangalore).

This subspecies has earlier been determined as *Theronia atalantae atalantae* (Poda), or simply as *Theronia* sp. (Rao, 1966, 1972). The following information on the biology of this subspecies is summarized from those reports:

Adults of *Theronia atalantae himalayensis* appeared in the middle of June in Srinagar. The females were seen flying over the congregations of pupae of *Lymantria obfusca* in search of suitable hosts. Freshly formed pupae were oviposited upon. In the laboratory freshly emerged adults paired immediately and mating lasted 8-15 minutes. The ratio of males to females was 1:2.

The egg is cream colored, elongate with one end narrower than the other, and measures about 2 mm. in length. It is laid in the body cavity of the pupa. The larva hatches in three days and starts feeding soon after. Once the parasite larva inside the host pupa is active, the latter stops all movements after about two days and becomes hard and stiff. The full grown parasite larva is yellowish in color and measures about 12-14 mm. in length and 3 mm. in width. It is tapering at the caudal end. Because of the developing parasite, the host turns slightly blackish between the fourth to ninth abdominal segments. The full grown larva spins a cocoon which forms a lining to the abdominal wall of the host. The parasite pupa is also yellowish in color. The adult parasite gnaws an irregular hole and comes out. Males emerge earlier than the females and are generally smaller in size.

The total life-cycle from the egg to the adult takes about 21-24 days.

This subspecies does not appear to show any preference for any particular ecological condition or host plant. In general the percentage parasitism varied from 2% to 20%, although Rao (1972) recorded as high as 40.82% parasitism in a *Salix* plantation and stated that 'It was a constant mortality factor operating against the pupae of *L. obfusca* in all the four experimental localities.'

Rao (1972) made some observations on the emergence of the moths from pupae that were pricked by *T. atalantae himalayensis* (as well as other pupal parasites). It was observed that the adult parasite fed on the host haemolymph after every prick. When freshly formed pupae were pricked either once or thrice, more parasites emerged than from 4-5 day old pupae pricked. The mortality of the pupae increased with increasing number of pricks. The moth emergence was greater when 4-5 day old pupae were pricked by the parasite, particularly after a single prick.

Rao (1966) also reported that, 'on one occasion, 4 parasite larvae were found feeding externally on a fourth instar larva of *L. obfusca* and one of them developed to adult stage in June 1963.'

2. THERONIA HILARIS HILARIS (Say)

Ichneumon hilaris Say, 1829. Contrib. Maclurean Lyceum Arts Sci., 1: 71. U.S.A.

Pimpla melanocephala Brullé, 1846. Hist. Nat. Insectes Hymén., 4: 99. North America. Name preoccupied.

Theronia melanocephala: Fernald, 1892. Bull. Hatch. Exp. Sta. Mass. State Coll., 19: 116. Massachusetts. Host: *Lymantria dispar*.

Theronia melanocephala: Viereck, 1917. Bull. Conn. Geol. Nat. Hist. Survey, 22: 323. Hosts: *Lymantria dispar* and others.

Theronia hilaris: Townes and Townes, 1960. U. S. Natl. Bull., 216(2): 356.

Theronia hilaris hilaris: Carlson, 1979. In Krombein *et al.*: Catalog of Hymenoptera in America. . . , 1: 347.

This subspecies was first mentioned (as *T. melanocephala*) by Fernald (1892) as a parasite of the gypsy moth in Massachusetts, U.S.A. Forbush and Fernald (1896) called it "the most abundant of the hymenopterous parasites" in 1895. Howard and Fiske (1911), however, considered that the record of *T. melanocephala* of Forbush and Fernald was actually of *T. fulvescens* [= *atalantae*] and that "the true *T. melanocephala* appears not to have been reared from this host." Campbell (1963) observed both *Theronia hilaris* (= *melanocephala*) and *T. atalantae*, attacking the gypsy moth in Glenville, N.Y. He, however, did not discuss *hilaris* further in that paper. It, therefore, appears that it is just an occasional parasite of the gypsy moth.

This subspecies is readily distinguished from *atalantae* by not having a ridge along the ventral margin of the hind femur and by its black head. It differs from the Eurasian subspecies of *hilaris* by its rufous thorax and abdomen. *T. hilaris laevigata* (Europe) and *T. hilaris nigra* (Japan and Siberia) are wholly black. The legs of *laevigata* are largely reddish, while those of *nigra* are wholly black.

No reared specimens from the gypsy moth have been seen. It is widely distributed in eastern and midwestern North America. Townes and Townes (1960) provides a detailed description and distributional data and Carlson (1979) records the hosts of *T. hilaris hilaris*.

Tribe PIMPLINI

Members of the tribe Pimplini are distinguished from the other tribes of Pimplinae by having a uniformly convex mesoscutum, without wrinkles, prepectal carina present, mesopleural suture with an angulation just above middle, propodeum without transverse carinae, often median carinae present at base and pleural carinae complete, tarsal claws of female, at least the front claws, nearly always with a basal tooth, areolet present (except rarely), nervellus intercepted variously, first tergite with a glymma, first sternite separate from first tergite, with dorsolateral carinae, subgenital plate of male transverse, with its apex truncate or retuse, and ovipositor long to very long, slender and of a uniform diameter.

The coloration is generally black. The pattern on hind tibia is rather characteristic, with apical and subbasal dark bands and median area and extreme base of tibia pale yellow.

Members of the Pimplini genera treated below are external parasites of

late larvae of various Lepidoptera that have just spun their cocoons, or those living in leaf rolls, etc. The development is completed upon the host larva within the cocoon. Two genera, *Acropimpla* and *Iseropus* are associated with the gypsy moth. *Gregopimpla* is treated here as a subgenus of *Iseropus*.

5. Genus ACROPIMPLA

Acropimpla Townes, 1960. U. S. Natl. Mus. Bull., 216(2): 159.

Townes (1969: 84) and Gupta and Tikar, (1976: 128) may be consulted for generic synonymy and affinities of the genus.

Some of the salient features of the genus are:

Body moderately long and slender, clypeus of male, and often the face of male white or yellow. Malar space very short to almost wanting. Face usually with its upper margin raised and often narrowly and strongly, or broadly cleft. Occipital carina complete, dipped a little on the mid-line above. Propodeum rather short and convex, with or without median longitudinal carinae. Areolet triangular, oblique, usually short petiolate, receiving second recurrent vein at its outer corner (sometimes the areolet lacking). Nervellus intercepted below middle. First tergite short and wide, its median dorsal and dorsolateral carinae rather strong. Second tergite with short, moderately strong oblique grooves cutting off its basolateral corners. Third and fourth tergites with distinct tubercles. Ovipositor straight, compressed, usually nearly as long as fore wing, but shorter in some species, its apex usually slender, seen in profile, concave above and the ridges on the tip of its lower valve very oblique.

Acropimpla is predominantly Oriental; but it also occurs in the Holarctic and Ethiopian regions. Their known hosts are several species of Microlepidoptera.

1. ACROPIMPLA DIDYMA (Gravenhorst)

Pimpla didyma Gravenhorst, 1829. Ichneumonologia Europaea, 3: 178. Europe.

Acropimpla didyma: Oehlke, 1967. Hymenopterorum Catalogus (novo editio), 2(1): 15. Host: *Lymantria dispar*.

This species was reported as a parasite of *Lymantria dispar* for the first time by Šedivý (1963) from Czechoslovakia, as *Ephialtes didymus* (Gravenhorst).

Female: Face polished, centrally raised, its upper margin straight. Mesoscutum hairy, subpolished. Mesopleurum and metapleurum polished and shiny, with scattered setiferous punctures. Propodeum with faint median carinae at base, which are somewhat divergent apically. Propodeum smooth dorsally, its pleural area with scattered punctures. Abdomen with coarse and scattered punctures. Tubercles on tergites punctate. Ovipositor long, as long as the fore wing.

Black. Face with an inverted crescentic yellow mark just below antennal sockets. Hind corner of pronotum, tegula, and wing bases, yellow. Legs yellowish-brown, with apical 0.3 of hind tibia, and tarsus except at extreme base, blackish.

Male: Generally similar to the female, but face more convex and with scattered punctures. Face and clypeus wholly yellow. Scape yellow ventrally. Hind margin of pronotum also yellow. Fore and middle legs more yellowish, lighter in coloration than the hind leg.

Length: 8 mm. Fore wing 6 mm.

Specimens and distribution: Several males and females from Europe examined in the Townes Collection. No reared specimens were seen. It is widely distributed in Europe.

Hosts: *Lymantria dispar* (vide Šedivý, 1963), and various other hosts belonging to the families Lasiocampidae and Noctuidae as mentioned by Šedivý (1963) and Aubert (1969).

This species runs to Group B and to *Acropimpla varuna* Gupta and Tikar from Java in the Gupta and Tikar (1976) Monograph on Oriental Pimplini. The two species are rather close. *A. varuna*, however, is distinguished by having a yellow scape in the female and the mesopleurum with a red mark in the dorsal half. The other European species of the genus, *A. pictipes* (Gravenhorst) is black, without yellow marks on face, and the propodeum and abdomen are coarsely sculptured.

6. Genus ISEROPUS (Figs. 5, 6, 130, 131)

Iseropus Foerster, 1868. Verh. Naturh. Ver. Rheinlande, 25: 164.

Gregopimpla Momoi, 1965. Mem. Amer. Ent. Inst., 5: 601. [Subgenus of *Iseropus*].

Body moderately slender and long. Clypeus of female black to yellow. Clypeus convex, its apical margin thin and with a median notch. Malar space short. Occipital carina complete, with a moderate dip medially above. Propodeum moderately convex, with median longitudinal carinae. Areolet present. Nervellus intercepted at or above the middle. First tergite short and wide, its dorsal and lateral carinae strong. Basolateral oblique grooves on second tergite moderately strong to obsolete. Third and fourth tergites with tubercles, their impunctate bands occupying about 0.2 their length. Ovipositor straight, compressed, its apex slender, concave above, the ridges of basal teeth very oblique. Ovipositor 0.5 to 0.8 as long as the fore wing.

Two subgenera are recognized: *Iseropus* (*Iseropus*) and *Iseropus* (*Gregopimpla*). Diagnostic characters are mentioned in the key that follows. Members of the genus are gregarious parasites of lepidopterous prepupae in thin cocoons, particularly of the families Lymantriidae, Lasiocampidae and Notodontidae.

Further taxonomic information may be obtained from Townes (1969) and Gupta and Tikar (1976). Information on larval morphology and affinities is provided by Short (1978).

Three species have been associated with the gypsy moth. They are *Iseropus* (*Iseropus*) *stercorator* Fabricius (= *Pimpla holmgreni* Schmiedeknecht), *Iseropus* (*Gregopimpla*) *himalayensis* (Cameron) (= *Iseropus hakonensis* Ashmead) and *Iseropus* (*Gregopimpla*) *inquisitor* (Scopoli).

KEY TO THE SUBGENERA AND SPECIES OF *ISEROPUS* ASSOCIATED WITH THE GYPSY MOTH

1. Interocellar distance 0.8 as great as ocellocular distance. Second tergite with conspicuous basolateral grooves. Abdominal tergites only moderately punctate, with shiny areas in between the punctures. Areolet as high as wide, more triangular in outline with second recurrent vein close to its middle. Face of male white. (Subgenus *Iseropus*).

1. stercorator Fabricius

Interocellar distance 1.25 as great as ocellocular distance. Second tergite with faint to indistinct basolateral grooves. Abdominal tergites wholly rather densely punctate. Areolet wider than high, more rectangular, with second recurrent vein close to its outer corner. Face of male black. (Subgenus *Gregopimpla*). 2

2. Face and metapleurum impunctate and shiny. Side of thorax shiny. Female flagellum 24-27 segmented. Median propodeal carinae extending up to 0.7-0.8 the length of propodeum. Propodeum evenly convex. Tergite 2 without oblique grooves. Legs slender, reddish, with hind tibia banded with fuscous and hind tarsus black except basally. Stigma pale brown. 2. *inquisitor* (Scopoli)

Face and metapleurum with coarse scattered punctures. Side of thorax with scattered punctures. Female flagellum 29-30 segmented. Median propodeal carinae confined to basal 0.5-0.6 of propodeum. Propodeum more convex in profile. Tergite 2 with faint oblique grooves. Legs a little thicker with bands on hind tibia rather conspicuously black and coxae and trochanters yellow marked. Stigma blackish-brown.

3. *himalayensis* (Cameron)

1. ISEROPUS (I.) STERCORATOR STERCORATOR (Fabricius) (Figs. 5, 131)

Ichneumon stercorator Fabricius, 1793. Entomologia Systematica, 2: 172. Germany.

Ichneumon graminellae Schrank, 1802. Fauna Boica, 2(2): 301. Czechoslovakia.

Pimpla Mussii Hartig, 1838. Jahresber. Forstschr. Forstwiss. Forstl. Naturk., 1: 253. Germany.

Pimpla Holmgreni Schmiedeknecht, 1888. Zool. Jahrb. System., 3: 448, 502. Germany.

Iseropus stercorator Roman, 1912. Zool. Bidr. Från Uppsala, 1:280.

Iseropus stercorator Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 29. syn., ref., distr., hosts, etc. Eurasia, Japan.

Iseropus stercorator Fab. in older literature was used as a senior synonym of *flavipes* Gravenhorst or a junior synonym of *inquisitor* Scopoli. It has also been cited as *stercorator* Gravenhorst. It appears that the host records are mixed up because of this confused nomenclature.

Rudow (1911) reported it as a parasite of *Lymantria dispar* and *L. monacha*, but in 1917 recorded only *monacha* as its host. Stadler (1933), Schedl (1936) and Thompson (1946) report it as a parasite of the gypsy moth under the name *Pimpla holmgreni*. No *Lymantria* hosts are mentioned by Oehlke (1967) or Aubert (1969).

The association of *Iseropus stercorator* with *Lymantria dispar* has not been confirmed by recent rearings.

Iseropus stercorator orgyiae (Ashmead) is the Nearctic subspecies.

Female and *male*: Face punctate, smoother along eye orbits and near base of clypeus. Clypeus subpolished, convex in basal half. Malar space short, 0.2 to 0.25 the basal width of mandible. Frons and vertex smooth, subpolished. Interocellar distance a little less than ocellocular distance (8:10). Mesoscutum hairy, subpolished with shallow indistinct punctures. Scutellum convex subpolished. Pronotum minutely punctate and with a smooth central area. Mesopleurum convex, polished, with minute punctures in the

prepectal area. Metapleurum polished and with a few scattered minute punctures. Propodeum largely smooth but the scattered punctures and rugosities at places, not convexly sloping, its median carinae divergent and extending only in the basal 0.5 of propodeum. Areolet triangular. First recurrent vein equal to the second. Nervellus intercepted at its upper 0.3. First tergite thinner, smoother laterally. Abdominal tergites with irregularly formed punctures with shiny interspaces. Swellings on tergites tending to be smoother. Oblique grooves on second tergite sharper. Ovipositor compressed, about 0.6-0.7 as long as the fore wing and the abdomen.

Female: Color black. Flagellum, clypeus and palpi brownish. Legs reddish-brown. Hind tibia with broad black subbasal and apical bands. Hind tarsal segments black in apical half (or more). Stigma and veins brown. Hind femur without fuscous mark. Tegula brown with a yellow anterior spot.

Male: Face, clypeus and scape ventrally, yellow. Fore and middle coxae with yellow spots. Otherwise like the female.

No reared specimens seen. Several European specimens examined in the Townes Collection.

Distribution and hosts: This subspecies is widespread in Europe and also occurs in Japan and eastern Russia. Several hosts have been reported by Aubert (1969: 42) belonging to the families Curculionidae, Tortricidae, Yponomeutidae, Oecophoridae, Gelechiidae, Pyralidae, Zygaenidae, Lasiocampidae, Notodontidae, Lymantridae, and Noctuidae. He does not mention any *Lymantria* species as host.

Iseropus (I.) stercorator stercorator is rather close to the Nearctic *stercorator orgyiae* (Ashmead), and *coelebs* (Walsh) and also to the Japanese *orientalis* Uchida. *I. stercorator orgyiae* differs from the nominate subspecies in having a black apical mark on the hind femur, white tegula, and rougher propodeum with longer median carinae. *I. coelebs* has denser punctures on the pronotum, mesopleurum and metapleurum, and elongate male claspers. Townes and Townes (1960) provide additional distinguishing characters. *I. orientalis* has pale labial palpi, pale tegula, black hind coxa and hind femur lightly fuscous apically. The side of thorax is shiny, with a few scattered punctures. The propodeum is more like that of *orgyiae* and *coelebs*.

2. ISEROPUS (GREGOPIMPLA) INQUISITOR (Scopoli) (Figs. 6, 130)

Ichneumon inquisitor Scopoli, 1763. Entomologia Carniolica Exhibens Insecta Carnioliae Indigena, p. 286.

Pimpla inquisitor Stadler, 1933. Ent. Anz., 13: 30.

Gregopimpla inquisitor Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 27. Eurasia. Host records after Meyer, 1934.

For further synonymical references refer to Oehlke (1967) and Aubert (1967).

The first report of this species (as *Pimpla inquisitor*) from gypsy moth could be traced only to Stadler (1933). The only other record is by Vasic (1958) from Yugoslavia. As mentioned under *I. stercorator*, the present species has been confused in the past with *stercorator* and it is not sure which of the two, if either, is really parasitic on the gypsy moth.

Aubert (1969) gave an elaborate list of hosts belonging to the following families of Coleoptera, Lepidoptera and Hymenoptera: Anobiidae, Curculionidae, Tortricidae, Cochylidae, Yponomeutidae, Pyralidae, Geometridae, Lasiocampidae, Lymantriidae, Noctuidae, Cephidae, and Tenthredinidae. He listed *Lymantria monacha* as a host after Brischke, 1878

(Brischke cited *Pimpla stercorator* 'Gravenhorst' ♂ = *flavipes*). He did not mention *L. dispar* as a host of this species. Oehlke (1967) did not mention any *Lymantria* hosts.

Male and female: Flagellum 24-27 segmented. Face smooth and shiny. Clypeus subpolished, not strongly convex. Interocellar distance a little more than the ocellocular distance (8:7). Frons and vertex smooth. Temple a little more convex than in *himalayensis*. Head in dorsal view quadrate. Mesoscutum subpolished, shiny, and with scattered punctures. Scutellum with scattered punctures and shiny. Pronotum polished. Mesopleurum and metapleurum polished and with scattered punctures. Propodeum evenly convex, its median carinae more parallel-sided and extending up to 0.7-0.8 the length of propodeum. Propodeum with shallow rugosities across middle. Nervellus intercepted at the middle or at upper 0.45. Areolet 1.5 as wide as high. Legs slender. Hind femur about 5.4 as long as wide. First tergite slender, its median carinae making an angle of 30° with the horizontal. Whole of abdomen densely punctate. Apical smooth bands on tergites a little wider than in *himalayensis*. Second tergite without grooves. Ovipositor about 0.85 as long as fore wing.

Black. Pedicel and basal flagellar segments ventrally yellowish. Palpi, hind corner of pronotum, and tegula yellow. Legs reddish-brown, with tibiae and tarsi a little paler. Hind tibia with conspicuous black bands. Hind tarsus black with basal 0.3 to 0.4 of first segment yellow. Stigma pale brown. In male, the fore and middle legs largely pale yellow and scape and pedicel yellow ventrally.

Specimens: Several males and females from Europe examined in the Townes Collection. No reared specimens seen.

Distribution and relationships: *Iseropus* (G.) *inquisitor* is distributed in Eurasia. It is close to *I. kuwanae* Viereck from Japan and is distinguished from the latter by having the hind tarsal segments largely black, first tergite slender, abdomen coarsely punctate, and propodeum being evenly convex. It differs from *I. himalayensis* by having a smoother face and metapleurum, slender hind femur, and median propodeal carinae extending up to 0.7 the length of propodeum.

3. ISEROPUS (GREGOPIMPLA) HIMALAYENSIS (Cameron)

Pimpla himalayensis Cameron, 1899. Mem. & Proc. Manchester Lit. Phil. Soc., 43(3): 178. India.

Epiurus hakonensis Ashmead, 1906. Proc. U. S. Natl. Mus., 30: 179. Japan.

Pimpla japonica Ulbricht, 1911. Soc. Ent. Stuttgart, 26: 54. Japan. Preoccupied. Host: *Samia cynthia pryeri*.

Epiurus satanus Morley, 1913. Fauna British India, Hymenoptera, 3(1): 173. India.

Itoplectis attaci Habermehl, 1917. Ztschr. f. Wiss. Insektenbiol., 13: 117. New name for *Pimpla japonica* Ulbricht.

Epiurus quersifoliae Uchida, 1928. J. Fac. Agr. Hokkaido Imp. Univ., 25: 59. Japan. Host: *Gastropacha quercifolia*.

Itoplectis attaci: Kamiya, 1934. Bull. Forst Exptl. Sta. Govt.-Gen. Chosen, 18: 66. Japan. Hosts: *Dendrolimus spectabilis*, *Lymantria dispar* (first record).

Gregopimpla himalayensis: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 26. China, India, Japan, Korea. Host records,

synonymical references.

Male and female: Flagellum 29-30 segmented. Face punctate below antennal sockets, smoother along inner orbits and near clypeus. Clypeus subpolished. Malar space 0.2 the basal width of mandible. Interocellar distance a little more than ocellocular distance (10:8). Frons and vertex polished, shiny. Mesoscutum elongate, leathery in texture. Scutellum with shallow punctures apically. Side of thorax shiny, polished with scattered shallow punctures on pronotum and mesopleurum. Metapleurum with more definite punctures than mesopleurum. Punctuation on metapleurum similar to that on face. Propodeum roundly convex, its median carinae confined to its basal 0.5, diverging apically and ending in a rugose band across propodeum. Basolateral areas of propodeum with scattered but definite punctures. Legs short, not slender. Hind femur 4.5 as long as wide. Nervellus intercepted at upper 0.4. Areolet elongate 1.5 to 2.0 as wide as long. First tergite short, convex, with sharp evenly arched median carinae, which may be a little angled medially. Second tergite without conspicuous basolateral grooves. Whole of abdomen densely punctate, only apices of tergites smoother. Ovipositor about 0.8 the length of fore wing.

Black. Antenna yellowish-brown ventrally. Maxillary palpi, tegula, and hind corner of pronotum, yellowish-brown. Legs brownish with yellowish-brown patches on fore and middle coxae, femora, and tibiae. Hind tibia with conspicuous fuscous sub-basal and apical bands, clearly separated by a wide yellow area. Hind tarsus blackish but first tarsal segment yellow on basal 0.5-0.6. Bases of other tarsal segments yellow.

Specimens examined: Several males and females from India and Japan in Townes and Gupta Collections. In the Townes Collection, a specimen bears the following data: "Emergued from pupa of *Lymantria dispar* on 5-VI-1930", "Kyushu, Fukuoka (Chikuzen)."

Distribution: Widespread throughout the northern belt of the Oriental Region (Northern India, China, Japan, and Korea).

Hosts: *Lymantria dispar*, and several other hosts in Japan and India [Townes, Townes & Gupta (1961) and Townes, Momoi & Townes (1965).] Kamiya (1934) first reported it from the gypsy moth (as *Itoplectis attaci*) in Japan.

Iseropus (G.) *himalayensis* is close to the Palearctic *I. (G.) bernuthii* (Hartig) in having similar punctuation of face, metapleurum, shorter hind femur and hind tibia distinctly banded (which characters separate these two from the other species of the subgenus *Gregopimpla*). *I. (G.) bernuthii*, however, is different from *himalayensis* in having parallel median propodeal carinae, propodeum rugose only in central area between carinae, propodeum dorsally flatter, and the fuscous bands on hind tibia not separated by a clear pale band.

II. SUBFAMILY PORIZONTINAE

Members of the subfamily Porizontinae are characterized by having an apically compressed abdomen, with spiracle placed behind the mid-length of first tergite. Clypeus usually not distinctly separated from face. Mandibular teeth usually equal. Notauli absent. Sternalus absent or short. Propodeum partly to completely areolated. Tarsal claws usually pectinate. Areolet present or absent—when areolet absent, intercubitus basad of second recurrent vein (except in Hellwigiini). Epipleurum of tergites 2-3 separated by a crease.

Subgenital plate transverse, not enlarged. Male clasper usually rounded apically. Ovipositor long or short, with a subapical dorsal notch and lower valve without teeth.

They are usually small sized species. They are usually primary internal parasites of lepidopterous larvae, except for some genera which parasitize larvae of Coleoptera, Raphidiidae or Tenthredinidae.

Six genera have been associated with the gypsy moth. They are keyed below:

KEY TO THE TRIBES AND GENERA OF PORIZONTINAE ASSOCIATED WITH THE GYPSY MOTH

1. Cross-section of petiole near its basal third depressed oval or circular. Suture separating its sternite from tergite at or above the mid-height, the suture always present. First tergite without a pit (glymma) before spiracle, sometimes a lateral groove may be present. (Porizontini). 2
- Cross-section of petiole near its basal third quadrangular or prismatic; suture separating its tergite from sternite below the mid-height, the suture present or obsolete. First tergite with or without a pit before its spiracle. (Macrini). 4
2. Pronotum narrow with a deeper groove. Epomia long and strong, almost reaching upper margin of pronotum. Propodeum narrowed towards apex, without carinae (except at base). Eyes distinctly emarginate just above antennal sockets. Ovipositor hardly exerted, as long as the apical depth on abdomen. 3. Casinaria
- Pronotum broad with a shallow groove in the middle. Epomia short, not extending to upper margin of pronotum. Propodeum short, not narrowed, apically, more convex in profile, with distinct transverse and longitudinal carinae. Ovipositor long, 0.5 to 1.0 as long as the abdomen. Eyes weakly emarginate. 3
3. Postpetiole broad, parallel-sided, flatter dorsally and with a lateral carina extending from spiracle to its apex. Basal part of petiole prismatic and flattened above. Frons with a weak median vertical carina. Combined areola and petiolar area of propodeum forming a broad, deep concave trough. 1. Sinophorus
- Postpetiole narrower, more globular in profile, without a lateral carina between spiracle and its apex. Petiole basally more cylindrical or depressed-oval. Frons with or without a median carina. Areola usually constricted posteriorly and the median trough not very deep. 2. Campoplex
4. Nervellus intercepted, though discoidella unpigmented. Areolet receiving second recurrent vein basad of its middle. Apical margin of clypeus with a short median tooth, which is sometimes rather weak. Glymma present. 4. Campoletis
- Nervellus not intercepted. Areolet receiving second recurrent vein at or distad of the middle. Clypeus without any median projection. Glymma present or absent. 5

5. Nervulus distad of basal vein by about 0.3 its length, strongly sloping to make an angle of about 70° with the discoidal vein. Clypeus rather wide, flat and with its apical margin truncate. Petiole without a conspicuous lateral pit or glymma. 5. Phobocampe
 Nervulus interstitial or only slightly distad of basal vein, almost vertical or slightly arched. Clypeus short and convex. Petiole with a distinct lateral pit or glymma. 6. Hyposoter

1. Genus SINOPHORUS (Fig. 43)

Sinophorus Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 153.

For taxonomical and synonymical references refer to Townes (1970) and Gupta and Maheshwary (1977).

Small sized insects, about 6-11 mm. long. Body stout. Fore wing 3 to 8 mm. long. Clypeus large and flat with apical margin weakly rounded and truncate. Mandible with a ventral lamella. Malar space 0.43 to 0.56 as long as the basal width of mandible. Frons with a weak median vertical carina. Eye weakly emarginate. Pronotum broad, with a shallow groove. Epomia short, not extending to upper margin of pronotum. Propodeum short, with areola and petiolar area completely confluent and forming a broad deep concave trough. Median longitudinal carinae of propodeum widely separated. Areolet present. Second recurrent vein inclivous. Nervellus usually not intercepted, the base of discoidella usually detached from nervellus. Petiole prismatic basally, the suture separating the tergite from sternite distinct and a little below the mid-height. First tergite without a lateral pit or glymma, but often with a shallow long groove. Postpetiole broad, parallel-sided, flatter dorsally and with a lateral carina extending from spiracle to its apex. Apex of male clasper rounded. Ovipositor about 1.7 to 2.1 as long as the hind femur.

Members of the genus *Sinophorus* are internal parasites of lepidopterous larvae or sometimes sawflies. This genus has not yet been certainly associated with the gypsy moth and the records in the literature appear erroneous.

1. SINOPHORUS VALIDUS (Cresson) (Fig. 43)

Rühl (1914) reported *Limnerium validum* Cresson (type-species of *Sinophorus*) as a parasite of *Lymantria dispar* in the U.S.A. on the authority of Timberlake (1912). Timberlake was working on the biology of *L. validum*, which is a parasite of *Euproctis chrysorrhoea*, and attempted to rear it on *Lymantria dispar*, but failed. Subsequent cataloguers like Stadler, Schedl, and Thompson, mentioned it as a parasite of the gypsy moth in Europe and North Africa—on whose authority is not clear.

Fusco and Simons (1973) mentioned *S. validus* as an unimportant native parasite of the gypsy moth found in association with the tent caterpillar and the webworm. Simons *et al.* (1979), quoting Carlson (1973, personal correspondence) mentioned that this species had been reared from the gypsy moth, but only rarely. However, Carlson (1979: 625) does not list *L. dispar* as a host of this species, and states, "I have listed only hosts from labels of specimens which I have identified as *validus*. Some of the host records in literature pertain to misidentifications in USNM collections."

It is thus evident that all records of this parasite ex gypsy moth are erroneous.

2. Genus CAMPOPLEX (Fig. 44, 134)

Campoplex Gravenhorst, 1829. Ichneumonologia Europaea, 3: 453.

For full synonymical and other references, refer to Townes (1970) and Gupta and Maheshwary (1977).

Body slender. Small-sized insects about 3-11 mm. long. Fore wing 2-8 mm. long. Clypeus weakly convex, its apical margin rounded, sometimes truncate, usually weakly depressed in the middle. Mandible with a ventral lamella, which is often weak. Malar space 0.4 to 0.8 as long as the basal width of mandible. Frons without a median carina, except rarely. Eye not or only weakly emarginate. Pronotum broad, with a shallow groove. Epomia short. Propodeum with its median longitudinal carinae somewhat closer (*cf. Sinophorus*) and angulate at the junction of areola and petiolar area—these two areas confluent but the junction between them discernible. Areola and petiolar area forming a flat, weakly depressed or a little excavated area, and not in the form of a broad deep trough. Areolet present, stalked or weakly sessile. Sometimes areolet absent. Second recurrent vein slanting outward. Nervellus usually intercepted. Petiole usually cylindrical in cross-section in basal 0.3, sometimes a little squarish. Postpetiole more globular in shape, usually wider in the middle, and somewhat raised in profile, without any lateral carina. Suture separating first tergite from sternite distinct and at middle or a little below middle. Glymma absent, but in its place usually a narrow, shallow groove present. Apex of male clasper broad and round, or sometimes with a shallow apico-dorsal emargination. Ovipositor 1.5 to 4.1 as long as the hind femur.

Ratzeburg (1844) recorded two species of *Campoplex* as parasites of the gypsy moth, *viz.*, *Campoplex difformis* Gravenhorst and *C. conicus* Ratzeburg. The latter species is a synonym of *Casinarina tenuiventris* (Gravenhorst). The identity of the species reported as *C. difformis* is uncertain, as according to several authors it has been a mixed and often misidentified species. Perhaps two different species, *C. difformis* and *Venturia deficiens* were involved, but the true identity of the species reared from the gypsy moth can only be decided when voucher specimens or freshly reared material turns up.

Campoplex deficiens Gravenhorst (= *algerica* Habermehl) is a species of *Venturia* (Horstmann, 1974). It is not discussed further.

Campoplex rapax Gravenhorst, as reported in the gypsy moth literature (Rudow, 1911) appears to be a species of *Hyposoter*. It has been referred to subsequently under *Anilasta* or *Anilastus*.

Momoi (1961) reported *Campoplex sugiharai* (Uchida) from *Lymantria dispar* in Japan.

Campoplex sp. of Burgess and Crossman (1929) is actually *Casinarina tenuiventris* (Gravenhorst).

Kolemietz (1958) reported *Omorgus* sp. as a parasite of the pupa of the gypsy moth, reared in August 1955 in Siberia. *Omorgus* is a synonym of *Campoplex*, the species of which are internal parasites of lepidopterous larvae, spinning their own cocoon after killing the host larva or prepupa and emerging from their own cocoons.

KEY TO THE SPECIES OF CAMPOPLEX ASSOCIATED
WITH THE GYPSY MOTH

1. Face rugulose. Abdomen wholly black. Hind femur, tibia and tarsus yellowish-brown. Occipital carina joining hypostomal carina at the base of mandible. Propodeal areola well formed in both the sexes, though widely open behind. Europe. 1. difformis (Gmelin)
- Face granulose. Abdomen reddish-brown laterally. Hind femur, tibia and tarsus blackish-brown to light brown. Occipital carina joining hypostomal carina just above the base of the mandible. Propodeal areola not well formed in the female, its median longitudinal carinae absent below costulae and weakly represented apically. Japan, Korea, Ryukyus, Thailand and southern India. 2. sugiharai (Uchida)

1. CAMPOPLEX DIFFORMIS (Gmelin) (Fig. 134)

Ichneumon difformis Gmelin, 1790. In Linnaeus: Systema Naturae, Ed. 13 1 (5): 2, 720. des. Type destroyed. (Neotype ♀, designated by Horstman (1969), the same specimen as the lectotype of *mutabilis* Holmgren).

Campoplex difformis: Gravenhorst, 1829. Ichneumonologia Europaea, 3: 458. Europe. (A mixed series).

Limneria mutabilis Holmgren, 1860. Svenska Vetensk. Akad. Handl. (N.F.) 2(8): 55. Lectotype ♀, labelled and designated by Hinz (1964, Entomophaga, 9: 70), Sweden: Småland (Stockholm).

Campoplex difformis Gravenhorst: Ratzeburg, 1844: 92. Host: *Lymantria dispar* (vide Bouché, Garten Ins., p. 154).

Horstman (1969) has shown that the true *Campoplex difformis* Gravenhorst, which is actually *Campoplex difformis* (Gmelin), is a senior synonym of *Campoplex mutabilis* (Holmgren), and that what most authors have called "*Campoplex difformis* Gravenhorst" is the same as *Venturia deficiens* Gravenhorst. Aubert (1975) rejects the neotype fixation of *difformis* by Horstman and considers *difformis* and *mutabilis* as different species. According to him the present species should be called *mutabilis* Holmgren, and *deficiens* Gravenhorst = *algerica* Habermehl, should be called *difformis* (Gmelin).

Whether true *difformis* (Gmelin) as described below is a parasite of *Lymantria dispar* or not, can only be ascertained by fresh rearings.

Male and female: Face rugulose. Clypeus, frons, and vertex granular. Malar space 0.6 the basal width of mandible. Interocellar distance 1.4 the ocellocular distance. Temple and vertex granuloso-mat. Occipital carina joining hypostomal carina at base of mandible. Mesoscutum granulose, tending to be rugose at places. Mesopleurum and metapleurum granulose, with a few scattered punctures. Scutellum granulose. Propodeum granulose in basal areas, transversely striate in apical half, particularly in petiolar area. Propodeal carinae rather strong, including the lateral longitudinal carina (which is weaker in other species). Areola wide, as wide or wider than the length of costula, rather widely open behind. Areola and petiolar area forming a rather wide trough as is usually seen in *Sinophorus*. Postpetiole finely granulose. Abdomen mat. Ovipositor as long as or a little shorter than the fore wing and longer than the abdomen.

Black. Mandible often partly brownish. Tegula yellow. Coxae black. Legs otherwise reddish-brown. Hind trochanters blackish-brown. Hind tibia and apex of hind femur fuscous. Tegula brown in the male.

Length: 6-7 mm. Fore wing 4.5 to 5 mm. Ovipositor 4.0 mm.

Specimens from Europe examined in the Townes Collection. No reared specimens seen.

2. CAMPOPLEX SUGIHARAI (Uchida)

Omorgus sugiharai Uchida, 1932. Trans. Sapporo Nat. Hist. Soc., 12: 74. Japan.

Campoplex sugiharai: Momoi, 1961. Kontyü, 29: 272. Japan, Korea.

Host: *Lymantria dispar*.

Campoplex sugiharai: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 276. Japan, Korea. Momoi, 1970. Pacific Insects, 12: 383. (Key and description of two subspecies from Thailand and Ryukyus). Gupta and Maheshwary, 1977. Ichneumonologia Orientalis, 4: 79.

This parasite has not been previously cited in the gypsy moth literature. It has the abdomen reddish-brown laterally and hind femur, tibia and tarsus blackish-brown to light brown. It occurs in the Orient and Japan.

Male and female: Face, frons, and vertex granulose. Clypeus finely granulose. Malar space 0.5 the basal width of mandible. Interocellar distance 1.0 to 1.2 as long as the ocellocular distance. Temple and occiput finely granuloso-mat. Occipital carina joining hypostomal carina a little above the base of mandible. Mesoscutum and scutellum strongly granulose. Pronotum granuloso-striate. Mesopleurum and metapleurum granulose, metapleurum more finely and densely so. Propodeum granulose. Petiolar area apically trans-striate. Basal transverse carina and the short carinae bounding basal area, the strongest. Areola not formed in female. Median longitudinal carinae erased, visible only in the apical half and enclosing a moderately deep trough-like petiolar area. Apical transverse carina visible laterally. In male median carinae joining basal transverse carina so that the areola is formed laterally. Areola a little constricted apically and widely confluent with petiolar area. Second lateral area and petiolar area of propodeum trans-rugulose. Hind coxa, and first and second tergites granulose. Petiole without a lateral pit or groove before spiracle, but with a fine lateral carina from base to the spiracle. Thyridium on second tergite small, oval and separated from base of second tergite by about 2.5 its length. Abdomen from third tergite onwards mat. Ovipositor long, about as long as the abdomen, 0.8 to 0.9 as long as the fore wing, evenly arched upwards.

Black. Mandible, palpi, and tegula partly or wholly, yellow. Fore and middle legs largely yellowish-brown, with their coxae often brownish to blackish. Hind coxa black. Hind leg otherwise dark brown with tibia centrally light brown. Abdomen brownish-black to black, with third and the following tergites yellowish-brown. Antenna brownish black to black.

Length: 7-9 mm. Fore wing 4 to 5.5 mm. Ovipositor 3.5 to 4.5 mm.

Momoi (1970) recognized three subspecies: *C. sugiharai sugiharai* (Uchida) from Japan and Korea, *C. s. okinawensis* Momoi from Ryukyus (Okinawa) and *C. s. australis* Momoi from Ryukyus (Omotodake) and Thailand. The three subspecies differ in the coloration of scape and pedicel (light brown to black

beneath), hind first trochanter (light brown to black), middle coxa (brown to black), tergites 3-8 (reddish-brown to black laterally), and hind femur (light reddish-brown to blackish-brown).

Specimens from Japan and Korea examined in the Townes Collection. No reared specimen seen.

A specimen from Naduvattom, S. India in the Townes Collection, agrees with this species, but comes somewhat in between *sugiharai sugiharai* and *sugiharai australis*.

Distribution and hosts: Momoi (1961) reported it as a widespread species in Japan and Korea and recorded *Lymantria dispar* as a host in Kyushu, Japan.

This species comes close to *Campoplex burmensis* Gupta and Maheshwary (1977) from Burma and *C. oriens* Gupta and Maheshwary from the Orient. It differs from the former in having a long ovipositor and areola not formed in the female. It differs from *oriens* in having blackish hind femur, and short, almost parallel-sided basal area.

3. Genus CASINARIA (Fig. 45, 135)

Casinaria Holmgren, 1859. Öfvers. Svenska Vetensk. Akad. Forh., 15: 325.

For full synonymical references, refer to Townes (1970). The Oriental species were treated by Gupta and Maheshwary (1977), and the Nearctic species by Walley (1947).

Body slender, with fore wing 4 to 9 mm. long. Eye margin strongly indented opposite antennal socket. Cheek short. Temple moderately short to very short and flat. Mesopleural suture, or at least its median 0.3, impressed as a sharp groove. Pronotum narrow, with epomia complete. Propodeum moderately long to very long, its apex between basal 0.3 and the apex of hind coxa. Propodeum usually with a median longitudinal trough, with incomplete areolation, or without carinae. Propodeal spiracle short, elongate-oval. Fore wing with areolet always present. Second recurrent vein usually inclivous. Nervellus not intercepted. Petiole cylindric or weakly depressed, moderately long to very long, the suture separating its sternite from tergite at or a little above the mid-height. Postpetiole a little bulbous. Glymma absent. Apex of male clasper rounded or a little elongate, without a subapical dorsal notch. Ovipositor short, 0.8 to 1.4 as long as the apical depth of abdomen, notched subapically.

This is a large genus of world-wide distribution. They are parasitic within lepidopterous caterpillars.

Two species of *Casinaria* are generally reported as parasites of the larvae of *Lymantria dispar*, viz., *Casinaria tenuiventris* (Gravenhorst) (= *Campoplex tenuiventris* Gravenhorst = *Campoplex conicus* Ratzeburg) and *C. ischnogaster* (Thomson). The record of the latter species is erroneous. Momoi (1963) added *Casinaria anastomosis* Uchida to the list of gypsy moth parasites in Japan. It is a junior synonym of *Casinaria nigripes* (Gravenhorst).

Morley and Rait-Smith (1933) recorded *Casinaria ischnogaster* as a parasite of *Lymantria dispar* on the authority of Morley (1914, Ichn. Britain, 5: 112). In the latter reference, Morley clearly states that records of the "synonymous *Campoplex conicus* from *Bombyx dispar* (Ratz., 1: 95), should be referred to Gravenhorst's species [*tenuiventris*], which Thomson also calls

C. latifrons Holmgr." He, in fact, did not record *C. ischnogaster* as a parasite of *Lymantria dispar* and was only clarifying the identity of *ischnogaster* vs. *tenuiventris* in the British fauna. *C. ischnogaster* is therefore to be removed from the list of gypsy moth parasites.

In literature two species of *Casinaria*, viz., *C. claviventris* Holmgren and *C. scutellaris* Tschek are reported as parasites of *Lymantria monacha*, the nun moth in Europe.

KEY TO THE CASINARIA SPECIES PARASITIC UPON THE GYPSY MOTH

1. Abdomen wholly black. All coxae and trochanters black. All femora and tibiae reddish-brown (except rarely the hind femur blackish).
Europe, USSR. 1. tenuiventris (Gravenhorst)
- Abdomen with at least tergites 3 and 4 red. Middle and hind legs almost wholly blackish, their tibiae lighter in basal half. Japan, Europe, USSR. 2. nigripes (Gravenhorst)

1. CASINARIA TENUIVENTRIS (Gravenhorst) (Figs. 45, 135)

Campoplex tenuiventris Gravenhorst, 1829. Ichneumonologia Europaea, 3: 482. Poland.

Campoplex conicus Ratzeburg, 1844. Die Ichneumonen der Forstinsecten, 1: 95. Germany. Host: *Lymantria dispar*. (Syn. by Dalla Torre, 1901-02: 126).

Casinaria latifrons Holmgren, 1858. Svensk. Vetensk. Akad. Handl., (2) 2(8): 50. (cf. Dalla Torre, 1901-02).

Casinaria tenuiventris: Brischke, 1880. Schrif. Naturf. Ges. Danzig, N.F. 4 (4): 147.

Campoplex sp. Burgess and Crossman, 1929. U. S. Dept. Agr. Tech. Bull., 86: 104. Larval parasite. France, Czechoslovakia.

For fuller synonymical references, see Dalla Torre (1901-02), Morley (1914), Meyer (1935), and Townes, Momoi and Townes (1965). Dalla Torre misspelled *Campoplex conicus* as *C. canonicus* Ratz. Howard and Fiske (1911) reported *C. tenuiventris* as a parasite of gypsy moth larvae, though the earliest record would be that of Ratzeburg (1844), as *Campoplex conicus*. I have examined specimens from France and Czechoslovakia that were mentioned by Burgess and Crossman as *Campoplex* sp.; these belong to the present species. In recent years, it has been mentioned as having been reared from the gypsy moth in Yugoslavia (Vasic, 1958), Russia (Shapiro, 1956) and Iran (Herard *et al.*, 1979)

Male and female: Face almost squarish, rugulose. Clypeus narrow, slightly convex, granulose, its apical margin convex and impressed. Mandible short and broad, with a wide lower lamella. Malar space 0.75 to 0.85 as long as the basal width of mandible. Temple strongly receding behind eye. Head lenticular. Frons granulose, without a median carina. Interocellar distance 1.4 as long as ocellocular distance. Lateral ocellar diameter about equal to ocellocular distance. Occipital carina strong, sinuate below lower level of eye and meeting hypostomal carina at the base of mandible. Mesoscutum convex, finely rugose. Scutellum rugulose, slightly convex with its lateral carinae confined to its front 0.4. Mesopleurum and metapleurum granuloso-rugulose.

Pleural area of propodeum more strongly sculptured than metapleurum, generally finely rugose. Dorsal face of propodeum rugose with a shallow and broad median groove along its length, which is beset with short transverse carinae. Propodeum coarser in male than in female, particularly in the median trough and areas laterad to it. Propodeum narrowed apically and extending to the basal 0.33 of hind coxa. Propodeal spiracle elongate-oval. Hind coxa granulose. Areolet moderate-sized, short petiolate, receiving second recurrent in the middle. Nervellus not intercepted, reclivous. First tergite 1.2 as long as the second, shorter than the hind femur. Abdomen not strongly compressed, clavate or rounded apically. Male claspers broader and rounded apically. Ovipositor short, straight, hardly exerted beyond the tip of abdomen. Ovipositor sheath a little clavate.

Black. Tegula black to yellowish-brown. Coxae and trochanters black. Legs otherwise reddish-brown with tarsi and apical 0.3-0.5 of hind tibia lightly fuscous. Sometimes hind femur and tibia dark, brownish or black, with tibia faintly banded. Abdomen wholly black. Middle femur may have basal black marks.

Length: 6-8 mm. Fore wing 3-4 mm.

Specimens: Germany: Würzburg, 1♂, June 1974, *ex Lymantria dispar*. France, 1♂, June 1981, *ex Lymantria dispar* (BIRL, Newark). France [Hyeres], 1♂, *ex Lymantria dispar*, V-28-1922, Gypsy Moth Lab No. 3438 (FIS. Hamden, Ct.) Czechoslovakia, Bilky, 1925, *ex Lymantria dispar*, No. 3475, 1♂ 1♀ (Hamden, Ct.), 1♂ 1♀ (USNM), 1♂ 1♀ (Townes). Bulgaria, 1924, *ex Lymantria dispar* (Hamden, Ct.) France: Foret des, May-June 1972-73, 3♀, *ex gypsy moth larvae* (EPL, Paris). Poland: Skiern., 1♀, June 1975, *ex gypsy moth larva* (EPL, Paris). China: Heilongjiang Province. Several males and females, reared from larvae of *Lymantria dispar* and *L. mathura* by Schaefer, *et al.* in May-June 1982.

Distribution: Europe, China, Iran (Herard *et al.*, 1979).

This species belongs to the Atrata Group of Gupta and Maheshwary, 1977. The specimens from China have the hind femur wholly black. It comes close to *C. natashae* Maheshwary & Gupta from the Himalaya.

Kolemietz (1958) mentioned rearing *Casinaria tenuiventris* (Gravenhorst) from gypsy moth larvae in Siberia during August 1954. It was considered rare. Pschorn-Walcher (1974) reported it (plus another species "red" = *nigripes*) from Southern France, Austria and Bavaria as an uncommon or rare parasite of young as well as of older larvae of the gypsy moth. The larval head of this species is figured by Short (1978).

Casinaria ischnogaster, wrongly reported as a gypsy moth parasite is close to *C. claviventris* in leg color and general body sculpture, but the head is not so lenticular, propodeum broad and short, rugose dorsally, and with its median groove shallow. The postpetiole is dilated at the level of the spiracle, then narrowed apically. In *C. claviventris* the outer posterior angle of discoidal cell is slightly obtuse, and the radial cell shorter and broader. *C. scutellaris* is unknown to me. The latter two species have been reported parasitic upon *Lymantria monacha*.

2. CASINARIA NIGRIPES (Gravenhorst)

Campoplex nigripes Gravenhorst, 1829. Ichneumonologia Europaea, 3: 598. Poland.

Casinaria nigripes: Thomson, 1887. Opuscula Entomologica, 11: 1102.

Casinaria anastomosis Uchida, 1930. Insecta Matsumurana, 4: 130.
Japan: Sapporo. New synonym. Host: *Ichthyura anastomosis*.

Fuller synonymical references to the two species can be found in Townes, Momoi and Townes (1965: 279). Momoi (1963: 54) first reported *Lymantria dispar* as a host of *anastomosis* in Japan. A recently bred specimen of this species from the gypsy moth in France is at hand.

Other host records are: *Ichthyura anastomosis*, *Orgyia gonostigma*, *O. thyellina* and *Epicnaptera ilicifolia* in Japan; and *Dasychira pudibunda*, *Orgyia antiqua*, *Dendrolimus pini*, and *D. sibiricus* in USSR. Its hyperparasites are *Itoplectis alternans* in Japan and USSR, and *Gelis areator*, *Gelis* sp., *Pteromalus* sp., and *Theronia atalantae* in USSR.

This species is readily distinguished by the red color of central abdominal tergites and blackish hind leg.

Male and *female*: Essentially similar in sculpture to *C. tenuiventris* and differing as follows:

Lateral ocellus separated from eye by about 0.7 its diameter. Interocellar distance 1.8 the ocellocular distance in female and about 2.0 in male. Malar space 0.5 to 0.7 the basal width of mandible. Areolet large, with a short petiole. First tergite 1.3 as long as propodeum, thinner than in *tenuiventris*, less widened apically. Propodeum somewhat coarser dorsally, particularly in male. In male median groove trans-carinate and lateral areas reticulate. Both petiolar area and lateral areas with irregular longitudinal incomplete carinae. Body sculpture coarser, tending to be finely rugose, particularly face, meso- and metapleurum.

Abdomen with apex of tergite 2 and tergites 3 and 4 wholly red. (Tergite 5 also red in one specimen before me.) Legs black with fore femur reddish and fore tibia and tarsus yellowish. Middle tibia and tarsus often yellowish-brown, particularly in male, and middle femur may also be brownish-yellow apically.

Length: 8-10 mm. Fore wing 5-7 mm. Larger than *C. tenuiventris*.

Specimens: S. France, 1♀, May-June 1972, ex gypsy moth larvae (EPL, Paris). Japan: Sapporo, 1♂, compared with type of *C. anastomosis* (Townes). Germany: 3♂, 3♀ det. as *C. nigripes* by Heinrich and by Teunissen (Townes). China: Heilongjiang Province, several ♂, ♀, ex *Lymantria mathura*, May-June 1982, P. Schaefer *et al.* (BIRL, Delaware).

Distribution: Europe, USSR, China, Japan.

Hosts: *Lymantria dispar*, *L. mathura*, and others, as mentioned above.

Pschorn-Walcher (1974) reported this as "*Casinaria* sp. red" from France, Austria and Bavaria as an uncommon parasite of the larvae of the gypsy moth, together with *C. tenuiventris*. He also referred to both of them collectively as "*Casinaria* spp."

4. Genus CAMPOLETIS (Fig. 46)

Campoletis Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 157.

For full synonymical references, refer to Townes (1970). *Anilastus* and *Anilasta* are junior synonyms of *Campoletis*, although in older literature *Anilastus* has been incorrectly but rather consistently used for *Hyposoter*. This was because of the misidentification of the type-species of *Anilastus*.

Small sized species with fore wing 3.3 to 7.5 mm. long. Body moderately

slender. Eyes weakly emarginate. Malar space small. Clypeus moderately wide, weakly to moderately convex, its apical margin with a median tooth of varying shape and size. Sometimes the tooth indistinct. Propodeal areola usually elongate, hexagonal, distinct from petiolar area or more or less fused with it. Areolet short petiolate, or pointed above, receiving second recurrent vein basad of its middle. Nervellus intercepted, discoidella unpigmented. First abdominal segment moderately decurved, with a moderately slender petiole and moderately stout postpetiole. Suture separating tergite from sternite below the mid-height of petiole. Glymma present. Thyridium sub-circular, separated from base of tergite by 0.7 to 1.5 its diameter. Ovipositor moderately stout, upcurved or almost straight, 1.6 to 3.5 as long as apical depth of abdomen.

Species of *Campoletis* have been occasionally collected from the larvae of the gypsy moth, recently in China (P. Schaefer) and France (EPL, Paris). Their specific identities are uncertain.

Species reported in the literature under *Anilastus* or *Anilasta*, like *Anilastus rapax* (Gravenhorst), or *Anilastus* n. sp. Stadler (1933) appear to belong to *Hyposoter*. Their specific identity is uncertain in the absence of the reared specimens. The figure of the larval remains in Stadler (1933) corresponds to that of *H. tricoloripes* (Viereck), which is known from Europe.

Two specimens of *Campoletis* bred from the gypsy moth in France are at hand. They are described below as *Campoletis* sp., because it is probable that the species has a name in Europe, but the name is unknown to me.

CAMPOLETIS sp.

Male: Face granuloso-punctate. Face and clypeus forming a convex surface, without a clear demarcation. Apical margin of clypeus convex and with a median acute tooth, which is rather well developed. Malar space about as wide as the basal width of mandible. Ocellar area punctate. Interocellar distance 1.4 the ocellocular distance. Ocellocular distance equal to ocellar diameter. Temple subconvex, not receding from eye. Thorax largely granulate. Areola granulate, open behind, a little constricted at its junction with petiolar area. Costula distinct. Petiolar area striate, subconcave and widened medially. Propodeal carinae more or less complete. Petiole and postpetiole finely granulate. Glymma in the form of a deep pit. Tergite 2 more than twice its basal width, mat. The following tergites subpolished.

Black. Mandible, palpi, fore and middle legs, pale yellowish-brown. Tegula yellow. Hind femur orange brown. Tibia whitish-yellow medially and base of hind tarsus yellowish-white. Second and following tergites reddish-brown laterally. Second and third also with faint reddish apical irregular bands.

Length: 5.5-6 mm. Fore wing 4 mm.

Specimens: South France, 2♂, May-June 1973 (EPL, Paris).

Cocoon: Silken white, slender, cylindrical, about 3.0 as long as its medial diameter.

5. Genus PHOBOCAMPE (Figs. 48, 136)

Phobocampe Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 156.

For full synonymical references, etc. refer to Townes (1970: 175).

Body short, with fore wing 4 to 6 mm. long. Eye margin weakly or not at

all indented opposite antennal sockets. Cheek short. Clypeal foveae not distinctly impressed, open. Clypeus weakly convex, with a subapical groove, the apex sharp, truncate or subtruncate. Mandible short, with a fringe on its lower margin, its teeth equal. Temple rather short. Occipital carina joining hypostomal carina. Lower corner of pronotum translucent. Mesopleurum mat to granulose. Posterior mesosternal carina complete, though often weak. Propodeum short, its areola and petiolar areas confluent or with a small constriction at their junction. Costula present. Propodeal spiracles circular or oval. Hind basitarsus without a ventral row of closely spaced hairs. Tarsal claws short and pectinate. Fore wing with areolet petiolate above, receiving second recurrent vein distad of its middle. Nervulus distad of basal vein by about 0.3 its length, strongly slanted, forming an angle of about 70° with the discoidal vein. Discoidella unpigmented, usually not reaching nervellus. Nervellus vertical and usually not intercepted. Petiole slender. Postpetiole rather broad. Suture separating sternite from tergite a little below the mid-height of petiole. Glymma small to obsolescent. Abdomen short and stout. Thyridium circular, separated from base of second tergite by about its diameter. Ovipositor about as long as the apical depth of abdomen, with a submedian notch.

The hosts are small or early instar lepidopterous caterpillars.

Viereck (1911) described *Hyposoter disparis* (now *Phobocampe uncinata*) as a parasite of gypsy moth larvae received in the U.S.A. from Russia. Howard and Fiske (1911) mentioned that they were first received in 1907 in a shipment of small gypsy moth caterpillars from Kiev, Russia. This parasite was subsequently released in Northeastern United States and has become established. It has, however, proved to be of little value in the control of the gypsy moth.

Burgess and Crossman (1929) mentioned having received specimens of two distinct species of *Hyposoter* in addition to *disparis* from Europe (Spain, Czechoslovakia, Hungary and Yugoslavia) during 1924, 1925 and 1927. The adults of these emerged from the cocoons in the same season in which they were formed, rather than hibernating in cocoons and issuing the following spring, as was the case in *disparis*. They also pointed out that such adults did not mate and oviposit and that "it seemed that they might hibernate. They were placed in several types of containers for hibernation, but the last one died after living 92 days." About the same specimens Muesebeck (1933) remarked, "*Hyposoter disparis* is easily confused with an unidentified species of the same genus which is occasionally reared as a parasite of the gypsy-moth larvae in Europe. The latter differs, however, in having the antennae 28-30 segmented; in the ocellocular line being slightly shorter than the diameter of an ocellus; in the less erect areolet of the anterior wing, with the second recurrent joining the cubitus very near the second intercubitus; and in having the petiolar area wider and uniformly closely granular and opaque."

The majority of these specimens represent a new species, *Phobocampe lymantriae*, while some from Hungary are *P. uncinata*. There are some variations in the two, which occur sympatrically in many areas in Europe. Both of them also occur in Japan.

Shapiro (1956) listed *Phobocampe pulchella* Thomson as one of the ichneumonid parasites of *Lymantria dispar* in Russia. Drea (in Doane and McManus, 1981: 31) also mentions *P. "pulchella* Thomson" as a parasite of the gypsy moth from Yugoslavia. This species is rather close to *P. uncinata*, but is a different species (lectotype examined). I suspect that the species involved might be either of the two European species of *Phobocampe* discussed here.

The record of Herard *et al.* (1979) of *Phobocampe* sp. from the gypsy moth in Iran concerns *P. uncinata*. A specimen of this material, now in Washington, has been examined. The record of Drea and Fuester (1979) of *Phobocampe*, n. sp. from Poland apparently pertains to *P. lymantriae*, which is sympatric with *uncinata*. Specimens collected by Fuester, located in Washington, have also been examined.

KEY TO THE PHOBOCAMPE SPECIES ASSOCIATED WITH THE GYPSY MOTH

1. Tergite 2 yellow or orange in apical half, sometimes this may be narrow (0.5 to 0.33); in males much narrower. Tergite I, often apically yellow in female. Postpetiole parallel-sided, laterally not distinctly margined, as long as or longer than wide. Propodeal areola usually constricted below costula, and median longitudinal carinae usually distinct. Areola and petiolar areas with transverse striations. Malar space 0.5 to 0.7 the basal width of mandible. Interocellar distance 1.3 to 1.5 the ocellocular distance. Ocellocular distance longer than ocellar diameter (rarely equal). Europe, USSR, Japan, and USA. 1. *uncinata* (Gravenhorst)
- Tergite 2 narrowly yellow apically (0.25-0.3); in male often without yellow band or only apicolaterally faintly yellow. Tergite I hardly yellow. Postpetiole rather sharply constricted from petiole, distinctly margined and convex laterally, wider than long, widest submedially. Propodeal areola not fully formed, not constricted, widely open below. Areola and petiolar areas granulose. Malar space 0.25-0.4 the basal width of mandible. Interocellar distance 1.7 to 1.9 the ocellocular distance. Ocellocular distance slightly shorter than ocellar diameter. Europe, Japan, U.S.A. 2. *lymantriae*, new species

1. PHOBOCAMPE UNICINCTA (Gravenhorst) (Figs. 49-51, 57-62, 136)

Campoplex uncinatus Gravenhorst, 1829. Ichneumonologia Europaea, 3: 529. ♀. (♂ misdet.).

Hyposoter disparis Viereck, 1911. Proc. U. S. Natl. Mus., 40: 478. ♂, ♀ [Kiev, USSR] "Gypsy moth Lab." Synonymized by Carlson (1979).

Limnerium disparis: Howard and Fiske, 1911. U. S. Dept. Agri. Bur. Ent. Bull., 91: 121, 191. Japan. Russia. Host: *Lymantria dispar*.

Phobocampe disparis: Townes, 1945. Mem. Amer. Ent. Soc., 11: 646.

Phobocampe uncinata: Carlson, 1979. In Krombein *et al.*: Catalog of Hymenoptera in America North of Mexico, 1: 661. Syn. Introduced in U. S. A.

Biological references: Howard and Fiske (1911), Burgess and Crossman (1929), Muesebeck and Parker (1933), Schedl (1936).

This species has so far been referred to as *Phobocampe disparis* or *Hyposoter disparis* and has only recently been synonymized under *P. uncinata* by Carlson (1979), after examining the types of *uncinata* and *disparis*.

This species was first discovered in the gypsy moth laboratory in Massachusetts in 1907 from a small collection of gypsy moth caterpillars imported from Kiev, Russia. In 1911 it was found in great abundance at Gioia Tauro,

Italy. The cocoons of it gathered from Italy were shipped to Massachusetts and adults that emerged the following spring (1912) were liberated around Melrose Highland. It was recovered from the field in 1913. It has apparently been recovered each year but only in small numbers. It has established itself in the U.S.A. but has not been able to exert much influence on the population of the gypsy moth.

Male and female: Antennal flagellum usually 28-32 segmented. Face strongly granulose. Clypeus finely granulose, its apical margin impressed and straight. Malar space 0.5 to 0.7 the basal width of mandible, a little wider in male than in female. Frons granulose. Vertex finely so. Interocellar distance smaller, 1.3 to 1.5 the ocellocular distance. Ocellocular distance longer than ocellar diameter. Temple and occiput subpolished and receding from the eye. Mesoscutum coarsely granulose. Scutellum finely granulose. Propleurum, mesopleurum and metapleurum granulose, but granulations finer than that of mesoscutum. Granulations on propleurum and speculum a little sparser and these areas somewhat shiny. Pronotal groove and prespecular area with carinations. Granulations on metapleurum somewhat similar to that of mesoscutum. Propodeum granulose in basolateral areas. Areas apicad of basal transverse carina with coarse granulations. Petiolar area and areola transcarinate, more so in female than in male. Sometimes males with granular areola. Propodeal carinae in general strong. Basal transverse carina usually strongly angled medially. Areola a little constricted apically (though open), its lateral carinae a little convergent or parallelsided and then widely diverging. Sometimes these carinae weak or obliterated just below costulae. Areola more flat and petiolar area a little concave. Propodeal spiracle oval, connected to pleural carina by a strong carina equal in length to the spiracular opening. Areolet small, petiolate with second recurrent vein emitted from its middle. Nervulus inclivous, distad of basal vein by about 0.3 to 0.33 its length, making an angle of 60° with the submedian vein. Discocubitus strongly arched. Petiole quadrate basally, a little flattened apically, gradually merging with the postpetiole. Postpetiole finely to coarsely granulose, parallel-sided, longer than wide or almost squarish. Postpetiole laterally not margined, the lateral carina thin or weak. Lateral groove of petiole weak. Tergite 2 narrower, elongate, more so in male, about 2.0 as long as its basal width in female and more than 2.0 in male. Thyridium irregularly round, separated from base of second tergite by a distance a little less than its maximum diameter. Spiracle of second tergite at its middle. Abdomen dull mat. Ovipositor as long as the apical depth of abdomen, or a little longer, finely tapered and slightly upcurved. Ovipositor sheath a little clavate apically. Female subgenital plate appears more hairy. Epipleurum of tergite IV with uniformly distributed hairs, not clustered along its margin.

Black. Mandible, palpi, fore and middle trochanters, and tegula, yellow. Scape and pedicel ventrally, hind corner of pronotum, fore and middle legs largely, and hind trochanters, yellowish. Sometimes fore and middle coxae, tibiae and trochanters more yellow than brown. Hind coxa and femur reddish-brown, tibia yellow to yellowish-brown and tarsus brownish. Apex of hind coxa, apex of femur, base and apical 0.25 of tibia, and tarsal segments apically infusate. Apex of postpetiole narrowly, thyridia and apical 0.33 to 0.5 of second tergite yellow to reddish-brown. In males yellow on first tergite absent. Second tergite apically usually amber colored or only narrowly or laterally yellowish-brown.

The propodeum exhibits some variations. Usually the areola and petiolar area are demarcated by a constriction and both have irregular carinations in

addition to granulations. Sometimes lateral carinae of areola are weak and areola may be more granular. But the nature of postpetiole, malar space and ocellocular distance in conjunction with the propodeal sculpture and the width of the yellow band on second tergite will distinguish it from the related *Phobocampe lymantriae*, n. sp. The males often have granular areola but they usually have faint or narrow apical band on second tergite and the malar space is larger than in the female. Other distinguishing characters also hold good for the male.

Length: 4 to 7 mm. Fore wing 3.5 to 5 mm.

Specimens: 30♂, 50♀, from: Italy [Gioia Tauro] April-May 1912. Veas, Hungary, May 1929. Var and Bouches du Rhone, France, May-June 1973. S. France, June 1972, May 1973. France, June 1980. Prilep, Yugoslavia, May-June 1973. Jovljak, Yugoslavia, May-June 1973. Trenton, Mass., U.S.A., May 1948. Lancaster Co., Pa., U.S.A., May 1977. Hawk Mts., Pa., May 1974. Mohonk Lake, N.Y., May, 1974, all reared from *Lymantria dispar*. Glenville, N.Y., June 1960. High Point State Park, N. J., May 1973. Starkoc. Boh., Czechoslovakia, July 1961 (not reared).

In addition, the following specimens also belong to this species: North Iran, Location A, 1♀, May 5-14, 1976, *ex Lymantria dispar*, Herard & Mercadier, EPL-Iran-76-2 (Washington). This has the postpetiole a little wider apically. Japan: Hokkaido: Hobetsu, 1♂, 1♀, June 15, 1978. *ex Lymantria dispar*, P. Schaefer, emerged Nov. 1978 (Washington). 3♀, Japan "APL-78-18C" and APL-77-26" (BIRL, Newark). 1♂, Eniwa, Hokkaido, June 3, 1977, reared, Herard. Honshu, Utsunomiya, 1♂, June 3, 1978, *ex Lymantria dispar* (BIRL, Newark).

The specimens from Japan labelled "APL-78-18C" and "APL-77-26" are typical *unicincta*, while the other specimens from Japan have somewhat less striate propodeum, hind femur is blackish, and the band on second tergite is narrow. They match with *unicincta* rather than with *lymantriae* in most of the characters. These have been previously labelled or mentioned as '*Phobocampe* n. sp.'

Cocoon: Cocoon uniformly dark brown in color, 6 x 4 mm., oval. Sometimes blackish-brown.

Distribution: Europe, USSR, Iran, Japan, and U.S.A. (Introduced).

This species is widespread in Europe and has definitely been established in northeastern United States. Pschorn-Walcher (1974) reported *Phobocampe unicincta* (= *disparis*) to be a dominant parasite of the gypsy moth in Würzburg, Germany, subdominant in eastern Austria, and of moderate abundance in southern France. Earlier, Burgess and Crossman (1929: 49) reported that it was scarce in Russia during their search in 1909-1910, but was found abundantly in Gioia Tauro, Italy in 1911. Muesebeck and Parker (1933) reported that specimens of this species have been received from various localities in Austria, Czechoslovakia, Poland, Hungary, Yugoslavia, Bulgaria and Italy. It appears to be most abundant in south-central Europe. In the United States it was recovered by them from Northeastern Massachusetts and Eastern United States. Since then it has been recovered from Pennsylvania, New Jersey and New York.

BIOLOGY

Phobocampe unicincta is a specific univoltine, internal parasite of *Lymantria dispar*. Parasitism is generally low, although on occasions heavy

parasitism has been observed in different parts of Europe. Apparently the parasitism is heavier in dense woodland than in open growth or on the outer edges of wooded areas. Muesebeck and Parker (1933) published on the biology of this species (as *Hyposoter disparis*). The following information is summarized from their paper:

Phobocampe uncinata, which was released in the areas of the New England states infested with the gypsy moth in 1912 onwards, has definitely become established, but has remained of little value as a control factor. Some of the factors that contribute to its ineffectiveness, are heavy hyperparasitization, much overwintering mortality, and much loss of the egg and first-instar larvae due to phagocytosis.

About 12,500 adults were liberated for the first time in four localities in eastern Massachusetts and one point in southeastern New Hampshire, in the spring of 1912 that were reared out of cocoons received in 1911 from Gioia Tauro, Italy. Importations ceased between 1912 and 1920. During 1924-1931 small numbers of the parasite were received from Hungary and Yugoslavia, and three small colonies were liberated in the field in Massachusetts during that time.

Collections of gypsy moth larvae were made at all the five points of 1912 release and the parasite recovered from each point.

Hibernation: *Phobocampe uncinata* hibernates as an adult within the cocoon. The posterior end of the body remains immersed in the moist meconial discharge. If the meconium dries, the parasite dies within the cocoon. In the field the cocoons remain on the surface of the ground throughout the winter, usually covered by leaf litter.

Emergence and mating: The adult *uncinata* emerges at about the time when eggs of the gypsy moth begin to hatch, usually in late April and early May. Temperatures of 65°F. or higher stimulate mating and sunlight is essential. Most satisfactory mating was obtained in the laboratory when freshly emerged females were mated with 3-4 day old males.

Oviposition: Females oviposit readily into the first and second instar larvae of the gypsy moth. The ovipositing parasite prefers to attack moving caterpillars and tends to prod caterpillars to move, when the ovipositor is quickly inserted and the egg deposited—the whole act taking just a second. The eggs are usually deposited in the posterior part of the body cavity. Several eggs may be deposited in one host but only one parasite matures.

Fecundity: The total number of eggs deposited by a female ranged between 182 to 1,228, in experiments of Muesebeck and Parker. The average number was 561. The longevity of the ovipositing female varied between 12 days to 54 days. In most cases the female continued to oviposit until the last day of her life, but the female that lived the longest deposited no egg after the 34th day. On a single day a female can deposit from 50 to 84 eggs.

Egg: The egg (Fig. 60) is 0.40 to 0.45 mm. in length and 0.11 to 0.14 mm. in maximum width. It is slightly curved on one side, smooth and pearly white. After deposition in the host, the egg gradually increases in size and before hatching attains a length of 0.7 to 0.8 mm. and a width of 0.25 to 0.28 mm. The duration of the egg stage is usually 7 days, which may extend up to 10 days when temperatures are low.

Larva: Five larval instars were distinguished by Muesebeck and Parker, although in other related parasites only three have been observed by several authors. Fig. 62 depicts larval mandibles.

The first larval instar is elongate more or less cylindrical, and smooth, with a strongly sclerotized brown head, and a long caudal appendage, which is

a prolongation of the last, or thirteenth, body segment. On hatching, the larva measures about 1.2 mm. in length, including the oval appendage, which itself is 0.30 to 0.35 mm. long. The mandibles (fig. A) are small, but heavily sclerotized and strongly hooked. The second larval instar is larger in size, with less sharply defined head, differently shaped and less sclerotized mandibles, and somewhat shorter caudal appendage. The larvae in the third and fourth instars are generally similar to the second larval instar, but larger in size and with differently shaped mandibles (fig. C, D). The fifth larval instar has more heavily sclerotized mandibles, the labial ring and the sclerotic framework in the mouth region are brown in color and conspicuous, body integument covered with minute tubercles, antennal leg and wing pads visible, and has nine pairs of open spiracles. The first pair of spiracles is situated near the posterior margin of the first thoracic segment, followed by a pair on each of the first eight abdominal segments. The caudal appendage is greatly reduced, resembling a short, thick, evenly tapering spine. The mature larva measures 8-10 mm.

The duration of each larval instar varies considerably, depending upon the temperature. The following averages are reported by Muesebeck and Parker after a large number of dissections:

I Instar	5 to 10 days
II Instar	2 to 5 days
III Instar	2 to 4 days
IV Instar	2 to 4 days
V Instar	1 to 2 days (within host)

The mature parasitic larva emerges from the fourth larval instar of the gypsy moth host. The host is killed several hours before the mature parasitic larva emerges. After emergence, practically nothing remains of the host larva.

Cocoon: The mature larva spins a cocoon on the underside of leaves or branches beside the dead host larva. The cocoon is ovoid in shape, measuring 6-7 mm. in length and 4 to 4.5 mm. in diameter (fig. 61). It is dark brown in color with a broad grey band around its middle. An outer layer of comparatively loose silk covers the dense tough more or less parchment-like envelope. The attachment of the cocoon to underside of leaf or host remains is rather weak so that the cocoon drops to the ground within 48 hours of its formation.

Pupa: Twenty-four hours after cocoon formation, the short caudal appendage retracts and becomes shrunken and dark in color. After four days within the cocoon, the larva exhibits a slight constriction at the posterior margin of the thoracic region and the developing eyes are weakly discernible. The meconium is usually cast about 6 days after the formation of the cocoon, and actual pupation occurs on the 9th or 10th day. The pupa darkens gradually, until at the end of about 5 days the head and thorax become black and the base of abdominal petiole begins to darken. Transformation into a adult usually occurs 20-21 days after cocoon formation. The pupal stage thus covers 11 days.

The adult within the cocoon is fully formed during the first half of July, although emergence does not occur until the following spring. There is thus only one generation per year. Rarely a male may emerge in the same season in which the cocoon was formed.

Muesebeck and Parker noted that the parasite dies within the cocoon if the meconium dries out. Consequently it is important that the cocoons be stored in sufficiently moist atmosphere to maintain the semiliquid condition of the

meconial discharge. Proper moisture conditions are important during shipment of cocoons and during hibernation in the laboratory.

Duration of various developmental stages

Egg	7-10 days
Larva	12-25 days
Prepupa	9-10 days
Pupa	10-11 days
Adult	12-54 days

The total life cycle thus covers from 50 days to 110 days and is temperature dependent.

Hyperparasites

Several hyperparasites were reared from shipments received from Italy during 1911 and 1912. These were:

Gelis areator (= *Hemiteles areator* Grav.).

Gelis sp. (3 unidentified species)

Theroscopus sp.

Spilocryptus pumilus Kriechbaumer

Bathythrix sp (= *Thysiotorus* sp.)

Theronia atalantae (Poda)

Itoplectis clavicornis (Thomson)

Itoplectis alternans (Gravenhorst)

Monodontomerus aereus Walker

Monodontomerus sp.

Haltichella maculipennis De Stefani

Eurytoma appendigaster (Swederus)

2. PHOBOCAMPE LYMANTRIAE, new species (Figs. 52-56)

Male and female: Similar to *P. uncinata* in general sculpture and color, and differing as follows:

Flagellum 26 to 28 (30) segments. Face somewhat rugulose. Malar space shorter, 0.33 ± 0.1 the basal width of mandible; in female usually 0.25 and in male 0.35-0.4. Interocellar distance longer, 1.8 ± 0.1 the ocellocular distance. Ocellocular distance slightly less than the ocellar diameter. Propodeum granulate, including petiolar area and areola, both of which are depressed and concave and without striations. Sometimes a few striations seen at the junction of areola and petiolar area only. Areola broadly open below costulae, not constricted apically, with median longitudinal carinae weak in this area. Propodeal carinae generally weaker. Basal transverse carina usually more roundly arched medially. Areolet larger, more oblique, with a short petiole and second recurrent vein at its outer corner. Nervulus usually distad of basal vein by 0.25 its length. Discocubitus roundly arched, not very strongly so. Postpetiole more abruptly widened from petiole. Junction between petiole and postpetiole appears constricted. Lateral groove on petiole deeper and more conspicuous than in *uncinata*. Postpetiole wider than long, its sides roundly

arched and margined by a distinct and sharp carina. Postpetiole widest at its middle. Tergite 2 wider, less than 2.0 as long as its basal width; in male a little narrower. Postpetiole finely granulose to mat, in males often granulose. Epipleurum of tergite 4 with denser hairs, clustered along its apical margin. Subgenital plate appears less hairy.

Black. Color similar to that of *P. uncinata*, but the black marks on hind coxa, apex of hind femur and base of hind tibia usually faint, obsolescent or even. Tergite 2 of female with a narrower yellow band, occupying its apical 0.25 only. Apex of tergite 1 hardly yellow. In males tergites 1 and 2 without yellow or orange bands, often extreme apex of tergite 2 brown.

Variations: A few specimens from Madrid, Spain; Veas, Hungary; and Bilky, Czechoslovakia; and a specimen each from Simantornya, Hungary; and Bibai, Hokkaido, K. Kamijo, July 11, 1962; are like *Phobocampe lymantriae* in the nature of malar space, interocellar distance, postpetiole and second tergite, but the propodeum is more like that of *P. uncinata* in that the basal transverse carina is angulate medially and areola and petiolar areas have more carinations. The hind coxa also has faint to somewhat distinct black apical marks. The malar space is rather small (0.2-0.25).

I believe these are *P. lymantriae*, as the areola is widely open behind, not constricted and the longitudinal carinae are weak.

Length: 4-7 mm. Fore wing 3.5 to 5 mm.

Holotype: ♀, SPAIN: Madrid, June 1925, *ex Lymantria dispar*, Gypsy moth Lab. (FIS, Hamden, Ct.)

Allotype: ♂: Same data as the holotype.

Paratypes: Spain: Same data as the holotype, 20♂, 80♀, June-July 1925 (Hamden). Czechoslovakia: Bilky, 4♂, 8♀, 1925, *ex Lymantria dispar*, Gypsy Moth Lab., No. 3475 (Hamden). Hungary: Olaszliszka, 3♀, June 25, 1927, *ex Lymantria dispar* (Hamden & Washington). Veas, Hungary, 1♂, 1♀, July 12, 1928, and July 6, 1929, Gypsy Moth Lab., No. 13039 D and 13044 C 3 (Hamden). Debreczen, Hungary, Gypsy Moth Lab., 2♂, No. 3469. Yugoslavia: Moscenica, 1♂, June 18, 1927, Gypsy Moth Lab., No. 13019 B (Hamden). Veas, Hungary, 7♂, 6♀, June 1928, *ex gypsy moth* (Washington). Nieborow, Poland, 1♂, 2♀, May 1975, Fuester & Mura, emer. June 1975. Skierniewice, Poland, 2♀, May-June 1975 Fuester & Drea. Burgenland, Austria, 1♂, April-June, 1974, Hoyer. South France, 2♂, 3♀, June 1972, J. Drea (Washington & EPL, Paris). Forêt d'Orleans (Loiret), France, 1♀, May 1974 (EPL, Paris). Bouches du Rhone, France, 1♂, June 1973, Fuester and Gruber (Washington). Westwood, Mass., 2♀, June 1929, Gypsy moth lab. No. 11532 (FIS, Hamden). Japan: Bibai, Hokkaido, 1♀, K. Kamijo, July 11, 1962, *ex Lymantria dispar* (Washington). Many specimens in Hamden collections were identified as "*Hyposoter* species."

Cocoon: Cocoon slender, oblong, light brown in color, often with black marks encircling the end opposite the exit hole and with a whitish silken central band, 3 x 6 mm. or smaller, but about 2.0 as long as wide. Cocoons generally smaller than those of *P. uncinata*.

Distribution: Europe (Spain, Czechoslovakia, Hungary, Yugoslavia, Poland, Austria and France). China. Japan. ?U.S.A. (Introduced). It is sympatric with *P. uncinata* over much of its range.

Biological notes: This species appears multivoltine, the adults emerge in the same season in which the cocoons are formed. According to Dysart (personal communication), Dr. Paul Schaefer also observed the multivoltine nature in *Phobocampe* species collected in southern Japan from the gypsy moth. The specimens examined from his collections, however, fit better with *uncinata*

rather than with *lymantriae*.

The specimen collected by Kamijo in 1962 is the only Japanese specimen fitting better under this species. The two specimens from Massachusetts, collected as early as 1929 are interesting. There is no evidence whether they were reared from the gypsy moth stocks in Europe or from Massachusetts. Most specimens from Europe were mixed and it is likely that both these species were released in the field. There is no evidence of its establishment in the U.S.A.

A series of specimens from China: Heilongjiang Province reared from *Lymantria dispar* in May-June 1982 by Schaefer *et al.* have been examined. They are *Ph. lymantriae*. A few have blackish hind femur, and propodeum a little coarser. Three males and a female were also reared on *Lymantria mathura* feeding on *Salix*. They also have darker hind femur.

6. Genus HYPOSOTER (Fig. 47)

Hyposoter Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 152.

For generic synonymy, refer to Townes, 1970: 181. Species of this genus associated with the gypsy moth have often been referred to under the genus *Anilastus*.

Moderately stout to slender species with fore wing 3.2 to 9 mm. long. Eye margin weakly to strongly indented opposite antennal sockets. Malar space 0.4 to 0.85 the basal width of mandible. Clypeus small, convex, its apex also convex. Lower edge of mandible with a basal lamella that is rather abruptly narrowed beyond the middle. Lower tooth of mandible a little smaller than the upper tooth. Temple short to very short. Occipital carina joining hypostomal carina. Thorax largely granulose to rugulose. Posterior mesosternal carina complete. Propodeal areola usually distinct and, in the species treated here, closed behind. Petiolar area concave and its bounding carinae often erased so that the combined petiolar area and third lateral area form a shallow trough. Propodeal spiracle circular to short elliptic. Hind basitarsus without a midventral row of closely spaced short hairs. Tarsal claws small, pectinate. Areolet present, with second recurrent vein near apex. Nervulus opposite basal vein or a little distad. Nervellus not intercepted, vertical to weakly reclivous. Glymma present in the form of a deep pit. Abdomen compressed apically. Thyridium circular or elliptic. Ovipositor short, 1.0 to 1.5 the apical depth of abdomen.

Members of the genus are parasitic within lepidopterous larvae.

Four species of *Hyposoter* have been mentioned in literature as parasitic on *Lymantria dispar*: *H. tricoloripes* (Viereck) in Europe, *H. fugitivus* (Say) in North America, and *H. vierecki* T.M. & T. [= *Campoplex* (*Diadegma*) *japonicus* Viereck] and *H. takagii* Matsumura in Japan. *H. lymantriae* (Cushman) occurs in India on the related *Lymantria obfuscata*.

Campoplex rapax Gravenhorst, often referred to under the genera *Anilastus* and *Anilasta*, appears to be a species of *Hyposoter*. It is unknown to me. *Anilastus* n. sp. (Stadler, 1933) is also a *Hyposoter*, most probably *H. tricoloripes*, judging from the figures of the larval remains.

'*Hyposoter* spp.' of Burgess and Crossman (1929) represents *Phobocampe lymantriae* from Spain, and Central Europe.

Hyposoter fugitivus (Say) (= *Limnerium* sp = *Limneria fugitiva*) was wrongly associated with the gypsy moth on guess-work. Its record in literature stems

from Howard and Fiske (1911: 138) who stated:
"A single cocoon, which was directly associated with the remains of the host caterpillars [*Lymantria dispar*] was collected by Mr. R. L. Webster in 1906 during his association with the laboratory. It was very likely that of *L. fugitiva* Say, but the fact will never be known, because a specimen of *Hemiteles utilis* Norton, a hyperparasite, actually emerged."

KEY TO THE SPECIES OF HYPOSOTER FROM THE GYPSY MOTH

- 1. Larger-sized species, 8-11 mm. long. Propodeum largely rugose, with basal areas somewhat rugoso-punctate. All coxae, trochanters and femora black, the anterior ones may be brown. Abdominal tergites marked with reddish-brown. Areola bounded by strong carinae. Japan, Korea, and China. 1. takagii (Matsumura)
Smaller-sized species, about 6-7 mm. long. Propodeum largely granu-lose. Petiolar area often rugose. Fore and middle trochanters yellow to yellowish-brown. All femora yellowish-brown. Coxae black or anterior ones yellow. Abdomen black. Areola bounded by weak to moderately strong carinae. (In *tricoloripes* hind femur often brownish, rarely black). 2
- 2. Fore and middle coxae and trochanters yellow. Propodeum in basal and lateral areas and inside areola granulate. Petiolar area granuloso-rugulose. In male sculpture coarser, with petiolar area rugulose. Slender species. Japan. 2. vierecki T.M.&T.
Fore and middle coxae black, as is hind coxa, or fore coxa partly yellowish-brown. Slender to moderately robust in build. 3
- 3. Hind femur and tibia often brownish though at times lighter in color. Areola crescentic, about 2.0 as wide as long, its apical closing carina complete and weakly arched. Propodeum largely granulate basolaterally. Pro-podeal sculpture finer than in *lymantriae*. Scutellum finely granulate. Second tergite granulate. Gastrocoeli usually deep and conspicuous. Europe. 3. tricoloripes (Viereck)
Hind femur reddish-brown. Hind tibia yellowish-brown with fuscous basal and apical marks. Areola horse-shoe shaped, its apical closing carina usually strongly concave, and carinae bounding areola often irregular or incomplete. Propodeum in general coarser than in *tricoloripes*, with lateral areas rugulose. Scutellum granuloso-punctate. Second tergite mat to weakly granulate. Gastrocoeli shallow. India. 4. lymantriae Cushman

1. HYPOSOTER TAKAGII (Matsumura)

Casinaria takagii Matsumura, 1926. J. College Agr. Hokkaido Imp. Univ., 18: 28. Korea. Host: *Dendrolimus spectabilis*.
Hyposoter takagii: Townes, Townes and Gupta, 1961. Mem. Amer. Ent. Inst., 1: 242. China, Japan, Korea.
Hyposoter takagii: Yasumatsu and Watanabe, 1964. Catalogue of Insect Natural Enemies of Injurious Insects in Japan, Pt. 1: 43. Hosts: *Lymantria dispar* (cf. Fukaya, 1950), *Dendrolimus spectabilis*,

Malacosoma neustria testacea (cf. Hayashi, 1933).

This species has often been misidentified in Japan as *Casinaria atrata* Morley (cf. Townes, Momoi and Townes, 1965: 300). It was first reported from the gypsy moth by Fukaya (1950). It is distinguished from other *Hyposoter* species by its larger size (8-11 mm.) and by the reddish marks on tergites.

Male and female: Face rugulose. Malar space 0.8 the basal width of mandible. Interocellar distance 1.7 to 1.8 the ocellocular distance. Vertex finely granuloso-mat. Mesoscutum granuloso-rugulose. Scutellum rugose. Mesopleurum rugulose to finely rugose. Metapleurum rugulose. Propodeum largely rugose, with basal areas somewhat rugoso-punctate to rugulose. Areola bounded with strong carinae. Areola pentagonal or hexagonal with its apical closing carina assuming various shapes—straight, arched, or angled. Median longitudinal carinae separating petiolar area from third lateral area weak to distinct and convergent apically. Postpetiole shiny or finely mat. Second and the following tergites mat to subpolished. Thyridium larger, wide, separated from base of second tergite by about half its width.

Black. Mandible partly to wholly, palpi, tegula partly (or not so), and fore and middle tibiae and tarsi, yellow. All coxae, trochanters and femora black to blackish-brown, particularly the anterior ones. Hind tibia and tarsus brown to blackish-brown. Abdomen black with some tergites often marked with reddish-brown. Abdomen never appearing wholly black. Color of legs and abdomen variable, with more or less of reddish color.

Specimens: Several males and females from Japan, China, and Korea examined, reared from *Dendrolimus spectabilis* and *Malacosoma neustria*. No specimen from the gypsy moth available.

Distribution: China, Japan and Korea.

2. HYPOSOTER VIERECKI T.M. & T.

Campoplex (Diadegma) japonicus Viereck, 1912. Proc. U. S. Natl. Mus., 42: 636. Name preoccupied by Cameron, 1906. Japan. "Gypsy Moth Lab. No. 1071".

Hyposoter vierecki Townes, Momoi & Townes, 1965. Mem. Amer. Ent. Inst., 5: 302. New name.

This species is readily distinguished from the others treated here by its yellowish-white fore and middle coxae and trochanters and yellowish-brown femora.

Male and female: Face and clypeus granulate. Malar space 0.65 the basal width of mandible. Interocellar distance 2.0 the ocellocular distance. Frons and vertex finely granulate. Thorax granulate. Pronotum and mesopleurum with a few striations interposed amongst granulations. Sculpture of scutellum a little coarser. Propodeum largely granulate. Combined petiolar and third lateral area ruguloso-granulate. Areola rectangular to squarish, its bounding carinae sharp to weak, apical closing carina angled medially. Areola rugulose to granulate. Costula incomplete. Sculpture of male propodeum coarser, particularly within areola and in petiolar area. Postpetiole and second tergite finely granulate. Other tergites progressively mat to subpolished. Thyridium rather small and narrow, separated from base of second tergite by about its width.

Black. Mandible, tegula and fore and middle coxae and trochanters, light yellow. Fore and middle legs otherwise yellowish-brown. Hind coxa black,

trochanters blackish, trochantellus in female yellowish-brown, femur brownish-yellow, tibia yellowish-brown with fuscous marks apically, and tarsus fuscous. Sometimes apex of hind femur and base of hind tibia also fuscous.

Length 6-7.5 mm. Fore wing 4-5.5 mm.

Specimens: Japan: 1♂ (type, No. 7258 of *Campoplex japonicus* Viereck), "Gypsy Moth Lab. No. 1071, June 21" (Washington). Japan: Kamifurano, Hokkaido, 1♂, 1♀, July 1, 1975, P. Schaefer, *ex Lymantria dispar* (Washington); 2♀, June-July 1975 (BIRL, Newark). Hobetsu, Hokkaido, 1♂ (broken), June 15, 1978, emerged June 25, 78, P. Schaefer (BIRL, Delaware). 1 ex (without abdomen), "Asagawa", June 16, 1923 (Washington).

According to Carlson (1979: 661) some of the records *Phobocampe uncinata* in Japan may pertain instead to the present species.

3. HYPOSOTER TRICOLORIPES (Viereck) (Figs. 63-67)

Anilastus tricoloripes Viereck, 1911. Proc. U. S. Natl. Mus., 40: 478.

Europe. "Gypsy Moth Lab. Nos. 1079 and 1065". Type is a female, not a male (no. 1079). Paratype is a male (no. 1065).

Limnerium (Anilastus) tricoloripes: Howard and Fiske, 1911, U. S. Dept. Agr. Bur. Ent. Bull., 91: 192.

This species has often been reared in Europe at different places from the gypsy moth and imported into the U.S.A. for release. In 1911, Howard and Fiske reported, "From time to time several specimens of *Limnerium* cocoons, all of them oblong in shape, and most of them partly concealed by the skin of the host caterpillar, have been received from Europe. In no instance they have been in sufficiently large numbers to make the species appear promising as a parasite."

Pschorn-Walcher (1974) reported it to be a larval parasite of low incidence in southern France, eastern Austria and Bavaria.

Male and female: Head granulose. Face a little coarser in male. Temple and occiput subpolished. Malar space 0.5 to 0.6 the basal width of mandible. Ocelli comparatively large, so that they appear somewhat closer to eye. Interocellar distance 2.2 to 2.3 the ocellocular distance. Mesoscutum, scutellum and mesopleurum granulose, almost of the same intensity. Speculum distinctly granulose, dull. Metapleurum a little finely granulose. Propodeum granulose. Petiolar area granuloso-rugose or rugulose in female and rugose in male. Areola granulose, crescentic, bounded by sharp carinae, about 2.0 as wide as long, closed apically. Costula complete to incomplete. Postpetiole and second tergite granulose. Rest of abdomen granuloso-mat to mat apically. Gastrocoeli deeply impressed, oval to crescentic, separated from base of second tergite by 0.5-0.7 its width. Ovipositor sheath appears a little widened apically. Ovipositor a little shorter than apical depth of abdomen.

Black. Mandible, palpi, tegula, and fore and middle trochanters, yellow. Fore and middle femora yellowish-brown to reddish-brown, their tibia and tarsi yellowish and with fuscous marks. All coxae black. Fore coxa sometimes apically brownish or yellow. Hind leg brownish, though at times lighter in color, or seldom hind femur blackish. Apex of tibia often darker, or hind tibia brown with its base pale yellow.

Length: 5.5-7.5 mm. Fore wing 4-5 mm.

Specimens: Europe: Type ♀ and paratype ♂, "Gypsy moth Lab., Nos. 1079 and 1065", Type No. 13799 (Washington). Europe: Several males and

females reared from the gypsy moth at Oberpullendorf, Austria, June 18, 1931; Austria, July 1932; Burgenland, Austria, May-July 1974; Orleans, France, June 1972 and May 1976; Neuf Brisach, France, May 1976; France, June 1980; and Nieborow, Poland, June 1975 (Hamden, Washington and Paris). The specimens in Hamden were identified as *Hyposoter* sp.

Distribution: Europe. The female type is rather abnormal. It is a small specimen with a very different areola—which is rather oblong and open apically. Viereck (1911) noticed this difference between the type and the paratype. I believe that the areola is rather abnormal in the type-specimen, as this condition is not seen in other specimens reared from the gypsy moth.

It appears that this species has been released in the U.S.A. in recent years but the results have not been encouraging. Drea and Fuester (1979) observed, 'Information on the biology of *H. tricoloripes* indicates that an alternative host is probably required for the species to complete its annual cycle. This may be the reason why this parasite has never become established in North America despite repeated releases.

4. HYPOSOTER LYMANTRIAE Cushman

Hyposoter lymantriae Cushman, 1927. Rec. Indian Mus., 29: 244. India: Kangra in Himachel Pradesh. Host: *Lymantria concolor*.

Hyposoter lymantriae: Beeson and Chatterjee, 1935. Indian Forest Rec. (N.S.) Ent., 1: 161. biol.

This species occurs in Northern India on *Lymantria obfuscata* and *Lymantria concolor*, which are related to the gypsy moth. It is rather close to the European *tricoloripes*, but is coarser in sculpture, with areola differently shaped and malar space and interocellar ratios a little different. The hind leg color is lighter.

Male and female: Head granulose. Temple and occiput subpolished. Malar space 0.75 the basal width of mandible. Ocelli comparatively small, appearing farther from the eye than in *tricoloripes*. Interocellar distance 1.8 to 2.0 the ocellocular distance. Mesoscutum granulose. Scutellum and mesopleurum granuloso-punctate. Speculum a little more convex and subpolished than in *tricoloripes* and finely weakly striate. Metapleurum and pleural area of propodeum weakly granulose, subpolished. Propodeum granulose on front half. Areola granulose to rugulose, more arched in front, its lateral carina and apical closing carina often weak or incomplete. Costula usually distinct and complete. Areola often irregular in outline. Second lateral area rugulose. Combined petiolar and third lateral area rugose. Postpetiole finely granulose. Second tergite mat to weakly granulose, and the following tergites mat to subpolished. Ovipositor sheaths appear slender. Ovipositor equal to apical depth of abdomen.

Black. Mandible, palpi, tegula, and fore and middle trochanters, yellow. Fore and middle femora yellowish-brown, their tibiae and tarsi yellow with pale brown marks. Hind femur reddish-brown, tibia yellowish-brown with apical and subbasal fuscous marks or bands. Hind tarsus brownish to blackish, with a pale basal band on first segment. Coxae black with fore coxae often yellow apically.

Length: 6-7 mm. Fore wing 4.5-5 mm.

Specimens: India: Kulu in Himachal Pradesh, 2♂, 2♀, and 2 broken sp., June 1964, ex larva of *Lymantria [obfuscata]* (Gupta). Kulu Dist.: Katrain,

ex larva of *Lymantria* [*obfuscata*], 1♂ (CIBC, Bangalore) and 1♀ (Washington). Katrain, Kulu, 1♀, June 26, 1965; Shambi, Kulu, 1♂, May 19, 1965, *ex* *Lymantria* [*obfuscata*] on *Alnus nitida*, and determined as *Anilastus* sp. (CIBC, Bangalore). Srinagar, 1♂, June 1969, *ex* *Lymantria obfuscata*, det. as *Hyposoter* sp. (CIBC, Bangalore). India: Kangra Forest, August 15, 1917, O. H. Walters Coll., 1♀ (type of *H. lymantriae*), parasite of *Lymantria concolor* (Washington).

Beeson and Chatterjee (1935) gave the following biological information: "Host: *Lymantria concolor* Walk. (Lymantriidae) defoliating *Quercus incana*." "The host is attacked in the early larval instars during June-July; the parasite matures in August and the host in September-October."

Dr. Roger Fuester (BIRL, Delaware) recently sent me specimens of this species, which were reared at Newark on the gypsy moth from stocks from Kulu District, India. It is intended to be released in the Northeastern U.S.A. against the gypsy moth.

III. SUBFAMILY ICHNEUMONINAE

Members of the subfamily Ichneumoninae are characterized by having the clypeus relatively flat, separated from the face by a weak groove, its apical margin weakly arcuate, or truncate, with or without a blunt median point. Upper tooth generally longer than the lower, notauli and sternaulus absent, or short and shallow, except rarely, propodeum steeply sloping in the petiolar area, with longitudinal carinae, areola present, variously shaped and often raised, propodeal spiracles linear (circular in some tribes that are not treated here), areolet pentagonal, the intercubiti convergent towards radius, abdomen flattened, usually spindle-shaped, first segment quadrate basally in cross section, with its spiracles placed far beyond the middle, postpetiole flattened and wide or pyramidally raised, gastrocoeli usually wide and distinctly impressed, and ovipositor generally short, hardly surpassing the tip of the abdomen. The female flagellum is usually widened preapically and the male flagellum is slender and tapering.

The species of Ichneumoninae are internal parasites of a variety of lepidopterous pupae. The oviposition is usually in the pupa but sometimes into the larva and the emergence from the pupa.

Several species of Ichneumoninae have been listed as parasites of the gypsy moth, chiefly in Europe. Most of them, however, have never been recorded subsequently and reared specimens are not available to confirm their occurrence on the gypsy moth. The only exception is *Lymantrichneumon disparis* (Poda), which was perhaps the first ichneumonid recorded from the gypsy moth and which has been collected subsequently in small numbers from the pupae of the gypsy moth.

There are some *lapsi* in the literature regarding the association of the ichneumonine species with the gypsy moth. Rudow (1911) listed several species as parasites of both *Lymantria monacha* and *L. dispar*, viz., *Ichneumon raptorius*, *I. sugillatorius*, *I. melanoceras*, *I. fabricator*, and *Trogus flavatorius*. In his subsequent lists (1917-1919) he was more specific as to the host records. In 1918, *Ichneumon raptorius*, *sugillatorius*, and *melanoceras* were listed as parasites of *Lymantria monacha* and not of *dispar*, while *I. fabricator* was not mentioned from either of them. These species are omitted here, except *I. fabricator*, which has been subsequently recorded as a gypsy moth parasite by Cecconi (1924) and Györfi (1963) and *Trogus flavatorius*, which

is the same as *Lymantrichneumon disparis*. There are a few other species, apparently first reported by Rudow (1917-19) from the gypsy moth, but missed by Schedl (1936) and Thompson (1946). These are included, although, as is usually the case, subsequent rearing records are lacking.

The identification of the genera and the species of the Ichneumoninae is somewhat difficult. In the keys that follow, attempts have been made to simplify them and a field key based largely on color is also given. For more information on the taxonomy of genera and species, the following works may be consulted: Heinrich (1960-62), Perkins (1953, 1959-60), Townes, Momoi and Townes (1965), and Kasparyan (1981).

KEY TO THE ICHNEUMONINAE ASSOCIATED WITH THE GYPSY MOTH, INCLUDING A FEW RELATED GENERA

1. Petiole wider than deep, flat above. Clypeus projecting forward, triangular in outline. Mandible strong, with one tooth. Body black, femora yellow. (Tribe *Pristocerotini*). 13. *Cotiheresiarches*
[*Cotiheresiarches dirus* (Wesmael)]
Petiole as deep as wide, squarish in cross-section. Otherwise not as above. 2
2. Clypeus wide, its apical margin thin and convex. Face and clypeus in an even plane. Temple strongly widened behind eye. Occipital carina reaching hind corner of mandible, not joining hypostomal carina. Mandible wide, not or very little tapered apically, both teeth prominent. (Tribe *Geodartiini*). 3
Clypeus narrower, its apical margin thicker and usually arcuate or truncate. Clypeus and face not forming a flat surface. Either clypeus and face with median convexities or their junction depressed. Temple moderately swollen. Occipital carina joining hypostomal carina. Mandible moderately narrow and tapered apically, with lower tooth often weak or small. 4
3. Tarsal claws not pectinate. Metapleurum separated from propodeum by a carina. (Recorded from *Lymantria* sp. and *L. monacha*. . . *Geodartia* (*G. cyanea*: Large size, 22 mm. Abdomen apically compressed, obtuse at apex and metallic bluish.
Tarsal claws pectinate to apex. Metapleurum separated from propodeum by a faint groove. *Pseudomaraces*
(*P. melli* Heinrich reported from *Lymantria* sp.)
4. Propodeum convex on front half or less (up to areola). Propodeum in profile view raised basally and then abruptly sloping. Areola usually constricted, horse-shoe shaped, or in the form of a raised polished 'boss', its bounding carinae often flat and polished. Incisures between tergites usually deep. Tribe *Ichneumonini* (*Protichneumonini*). . . . 5
Propodeum flat on basal half and then sloping. In profile view propodeum making an inclined slope. Areola normally formed, squarish or elongate, or sometimes arched basally. Tribe *Joppini*. 8
5. Areola reduced to a small polished boss that is strongly elevated, its bounding carinae obsolete. Apex of female abdomen blunt (amblypygous).

- Gastrocoeli shallow and wide. 3. Callajoppa
 [*Callajoppa cirrogaster cirrogaster* (Schrank)].
- Areola normal or somewhat normal, bounded by distinct carinae. Apex of female abdomen acute (oxypygous). Gastrocoeli usually deep. 6
6. Abdomen black or bluish-black, with or without white spots, spindle-shaped, a little narrower than thorax. Areola within the general convex surface of propodeum, not distinctly raised, usually horse-shoe shaped or hexagonal. 4. Ichneumon
 (Several species).
- Abdomen more parallel-sided, reddish or brownish, as wide as thorax. Areola raised above the general surface of propodeum, propodeum sloped away from areola on all sides. *Protichneumon* and related genera. 7
7. Scutellum flat, polished. Areola rugose, longer than wide. Postpetiole not pyramidally raised. Head and thorax black. Abdomen reddish. Wings clear hyaline. 2. Paracoelichneumon
 [*Paracoelichneumon rubens* (Fonscolombe)].
- Scutellum subconvex, punctate. Areola horse-shoe shaped, smooth. Postpetiole somewhat pyramidally raised medially. Body yellowish-brown with wings yellow tinged. 1. Lymantrichneumon
 [*Lymantrichneumon disparis* (Poda)].
8. Thyridia very wide, the space between them less than 0.7 the width of each. 9
- Thyridia of moderate width or narrower, the space between them more than 0.7 the width of each. Thyridia usually weakly impressed. 10
9. Lateral carina of scutellum sharp and strong up to apex of scutellum. Postpetiole granulose to punctate, usually without a defined median field. 5. Stenaoplus
 [*Stenaoplus pictus* (Gravenhorst)].
- Lateral carina of scutellum ending at basal 0.2 to 0.3. Postpetiole with a distinct median field, which is striate. Stenichneumon
 (not associated with the gypsy moth).
10. Extreme base of propodeum with a weak median tubercle. Median field of postpetiole with moderately dense punctures. Apical half of female flagellum strongly flattened below, tapering apically. 6. Melanichneumon
 [*Melanichneumon leucocheilus* (Wesmael)].
- Base of propodeum without any median tubercle. Median part of postpetiole with fine to distinct longitudinal striations or aciculations. Apical half of female flagellum cylindric, blunt or tapering apically. 11
11. Median field of postpetiole not sharply demarcated, with fine weak striations and punctures. Apical half of female flagellum cylindric or weakly flattened below. 7. Cratichneumon
 [*Cratichneumon fabricator* (Fabricius)].
- Median field of postpetiole demarcated and usually aciculate or strongly striate. Apical half of female flagellum with a short to long taper, or somewhat blunt apically (In *Spilichneumon occisor*, postpetiole finely

- striate with smoother apex, and median field rather weakly demarcated).
Scutellum yellow. 12
12. Tip of abdomen acutely pointed (oxypygous). Ovipositor not unusually short, distinctly exerted beyond abdominal tip. Subgenital plate not elongate. Sternite 4 membranous medially (usually medially folded). 13
- Tip of abdomen rounded (amblypygous). Ovipositor unusually short, hardly exerted. Subgenital plate sometimes with a median prolongation. Sternite 4 often not membranous medially. 14
13. Apical margin of clypeus broadly, weakly concave, with a weak, broad, median tooth. Apical part of female flagellum blunt, not distinctly tapered before the last segment. 8. Chasmias
[*Chasmias paludator* (Desvignes)].
- Apical margin of clypeus truncate or weakly convex, without a median tooth. Apical part of female flagellum weakly tapered. 9. Pterocormus
[*Pterocormus sarcitorius sarcitorius* (Linnaeus)].
14. Flagellum short, its second segment 0.8 to 1.4 as long as wide, its apex with a short taper. Sternite 4 not membranous medially. 15
- Flagellum long, slender, its second segment 1.4 to 3.0 as long as wide, its apex with a long taper. Sternite 4 often membranous medially. 16
15. Areola about 1.0 as long as wide. Sides of median field of postpetiole sharply defined. 10. Triptognathus
[*Triptognathus amatorius* (Mueller)].
- Areola about 1.8 as long as wide. Side of median field of postpetiole indistinctly defined. 11. Spilichneumon
[*Spilichneumon occisor* (Fabricius)].
16. Subgenital plate with a median apical tuft of suberect hairs. Eutanyacra
[Not associated with the gypsy moth].
- Subgenital plate without a median apical tuft of hairs, often with a few longer hairs on its apex but these sparse and either decumbent or only weakly raised. 17
17. Propodeum with an acute tooth at apex of its second lateral area on either side. 12. Amblyteles
[*Amblyteles armatorius* (Foerster)].
- Propodeum without teeth. Diphyus
[Not associated with the gypsy moth].

FIELD KEY FOR THE IDENTIFICATION OF ICHNEUMONINE PARASITES ASSOCIATED WITH THE GYPSY MOTH

1. Body wholly black. Legs may have yellow or brown marks. Wings clear hyaline or a little infuscate. 2
- Body wholly to largely rufous brown, or black with abdomen striped, or thorax black and abdomen reddish or rufous. 8

2. Size large, 15 to 18 mm. long. 3
 Size small, 12 mm. or less. 7
3. Fore and middle legs rufous. Scutellum black. 4
 All legs black. Scutellum yellow (or black in *dirus*). 5
4. Antenna black. Wings infusate (according to original description). Hind
 leg wholly black. Not seen. . . . ♂, ♀. "Amblyteles varipes Rudow."
 Antenna brownish-black. Wings clear hyaline. Hind femur and tibia
 reddish. ♂. Chasmias paludator (Desvignes)
5. Abdomen with white spots on tergites 2-3 in ♀ and 2-4 in ♂. Areola flat.
 ♂, ♀. Ichneumon cyaniventris Wesmael
 (*Ichneumon sugillatorius*, ex *Lymantria monacha*, very much like the above
 but the areola more convex).
 Abdomen wholly black, without spots. Areola convex, a little raised. . 6
6. All femora yellowish-brown. Clypeal margin triangular, its apex project-
 ing forward. Abdomen robust. Petiole flat above. Scutellum black,
 convex. ♀. Cotihersiarches dirus Wesmael
 All femora black. Legs wholly black, except in males where fore and
 middle legs with brownish patches. Clypeal margin truncate or arcuate,
 its apex not projecting forward. Abdomen spindle-shaped, slender.
 Petiole quadrate in cross section. Scutellum yellow and flat.
 ♂, ♀. Ichneumon leucocerus Gravenhorst
 (Incorrect record. Occurrence on the gypsy moth not confirmed).
7. Face strongly punctate. Body conspicuously marked with red and yellow.
 Inner orbits yellow. Scutellum yellow at apex. All femora reddish.
 Hind tibia without a yellow median band. Size 6-10 mm.
 ♂. Stenaoplus pictus (Gravenhorst)
 Face with scattered punctures. Body largely black, not conspicuously
 marked. Face wholly black (♀), or largely yellow (♂). Scutellum black
 (♀) or apically yellow (♂). All femora reddish (♀) with tibiae yellow
 medially, or hind leg wholly brownish-black (♂). Size 8-11 mm.
 ♂, ♀. Cratichneumon fabricator (Fabricius)
8. Body largely to wholly rufous-brown. Thorax may have black patches.
 Abdominal tip may be black. 9
 Body black with abdomen banded or wholly reddish. Thorax black. Head
 black or partly yellow. 10
9. Head, thorax, abdomen, and legs largely rufous brown. Abdomen black
 tipped. Gastrocoeli deep and wide. Postpetiole coarsely striato-
 punctate. Wings yellowish-brown. Size 17 mm. or more, large.
 ♂, ♀. Lymantrichneumon disparis (Poda)
 (Some Japanese specimens have less or more extensive black marks on
 thorax, abdomen and legs).
 Head blackish, except for face. Propodeum blackish. Rest of body
 including tip of abdomen rufous. Gastrocoeli shallow. Postpetiole
 granulose. Size small, 7-10 mm. . ♀. Stenaoplus pictus (Gravenhorst)

10. Thorax black. Head wholly black or dorsally black. Abdomen reddish or yellowish-brown, with or without black on its apex. Abdominal tergites not banded. Wings tinged or clear hyaline. 11
 Thorax black. Head black. Abdomen banded (yellow and black, or red and black). Wings clear hyaline. 15
11. Size large, 20 mm. and over. Abdomen yellowish-brown, with apex black. Wings lightly to strongly yellow-tinged. Flagellum not banded. Scutellum subconvex to pyramidal. Areola quadrate or in the form of a polished boss. 12
 Size medium, less than 20 mm. long. Wings clear hyaline or a little tinged. Abdomen reddish. Flagellum with a white band in ♀. Areola elongate and rugose. Scutellum flat. 13
12. Scutellum pyramidal. Areola in the form of an elevated polished boss. Wings strongly tinged with yellow. Basal four tergites yellow.
 ♂, ♀. Callajoppa cirrogaster cirrogaster (Schrank)
 Scutellum subconvex. Areola quadrate, well formed. Wings lightly tinged with yellow. Basal segment of abdomen and fourth and the following segments black, only 2-3 segments yellow.
 ♂. Triptognathus amatorius (Mueller)
13. Tip of abdomen white marked. Abdominal tergites 2-4 reddish (♀) or with reddish bands (♂). Gastrocoeli and thyridia weak, indistinct.
 ♂, ♀. Melanichneumon leucocheilus (Wesmael)
 Tip of abdomen black or red. Scutellum yellow. Areola elongate and rugose. 14
14. Abdomen beyond tergite 3 black. Tergite 7 may have a longitudinal yellowish mark. Gastrocoeli weak and short. 4th sternite membranous medially. Tip of flagellum blunt. Propodeum flat basally. Size 14-15 mm. ♀. Chasmias paludator (Desvignes)
 Abdomen red except for tergite 1. Gastrocoeli deep and wide. 4th sternite wholly sclerotized. Flagellar tip pointed. Propodeum convex basally. ♀. Paracoelichneumon rubens (Fonscolombe)
15. Females. Flagellum with or without a white band. 16
 Males. Flagellum without a white band. 19
16. Second tergite black, only narrowly yellow basally. (Abdominal tergites black with yellow bands). Propodeum with a sublateral acute tooth on either side. Flagellum slender, finely tapered, without a white band.
 ♀. Amblyteles armatorius (Förster)
 Second tergite red. Propodeum without sublateral teeth. Flagellum short, curled apically and short tapered, with an indistinct white band. . . 17
17. Third tergite also red. Tergites 4-6 with median apical yellow incomplete bands. Median field of postpetiole less strongly demarcated and finely striate. Mandible not narrowed apically. Flagellum narrowed apically.
 ♀. Spilichneumon occisor (Fabricius)
 Third tergite largely black, with yellow apical margin or red with base broadly black. Median field of postpetiole clearly defined and distinctly striate. Mandible slightly to strongly narrowed apically. 18

18. Third and the following tergites black with narrow apical yellow stripes. Abdominal tip amblypygous. Tip of flagellum tapered apically. Femora black. ♀. Triptognathus amatorius (Mueller)
 Third tergite black in basal 0.4 and red in apical 0.6. Tergites 4, 5, and 7 wholly black. Tergite 6 largely yellow. Abdomen oxypygous. Flagellum rather blunt apically. Short tapered. Femora red.
 ♀. Pterocormus sarcitorius sarcitorius (Linnaeus)
19. Second tergite yellow on basal half or more. Third tergite wholly to largely yellow. Hind femur largely to wholly black. Face without a black mark. 20
 Second and third tergites largely black, with yellow apical concave stripes. (Abdomen banded by yellow and black). Face with a black mark. Hind femur yellow on basal 0.75.
 ♂. Pterocormus sarcitorius sarcitorius (Linnaeus)
20. Propodeum with a sharp tooth on either side. Flagellum brown. Hind femur yellow on basal 0.25, otherwise black. Tergites 4-5 black.
 ♂. Amblyteles armatorius (Förster)
 Propodeum without teeth. Flagellum black. Hind femur wholly black. Tergites 4-5 with yellow apical bands.
 ♂. Spilichneumon occisor (Fabricius)

TRIBE ICHNEUMONINI (= PROTICHNEUMONINI)

1. Genus LYMANTRICHNEUMON

Lymantrichneumon Heinrich, 1968. Ent. Tidskr., 89(1-2): 104.

Mandible apically narrowed and twisted so that the small lower tooth lies behind the long and pointed upper tooth. Flagellum of female a little widened subapically. Scutellum convex, raised from metascutellum and punctate. Its lateral carina confined in its basal 0.3. Mesopleurum coarsely punctate. Mesepisternum without a knob-like protuberance near middle coxa at its junction with mesosternum, so that in profile view this area does not appear concave (*cf. Protichneumon*). Propodeum with a horse-shoe shaped high areola. Petiolar area concave and abruptly sloping. Postpetiole wide, knob-like. Gastrocoeli deep and wide, the interspace between them about 0.7 as long as the width of gastrocoeli. Abdomen punctate and acute apically in the female (oxypygous).

Color yellowish-brown with wings tinged with yellow. The Japanese specimens often with black parts.

Heinrich (1968) segregated *Lymantrichneumon* from *Protichneumon* for the reception of those species which are parasitic upon Lymantriidae rather than Sphingidae. He distinguished *Lymantrichneumon* from *Protichneumon* by the absence of a raised knob-like projection on mesepisternum near middle coxa in the region of sternaulus, which is angled broadly with mesosternum, convex propodeum at a level higher than that of metascutellum, apical margin of mesosternum not concave and raised, and mesoscutum densely punctate. He further separated it on its body color: yellowish to orange brown with yellow-tinged wings.

Heinrich (1960) stated that the females of the tribe Protichneumonini do not

hibernate as adults and probably produce only one generation per year, while the adult of *Lymantrichneumon* does hibernate.

1. LYMANTRICHNEUMON DISPARIS (Poda)

Sphex disparis Poda, 1761. Insecta Musei Graecensis, p. 107, no. 3.

Europe. Host: *Lymantria dispar*.

Protichneumon disparis: Morley, 1903. Ichneumonologia Britannica, 1: 20.

Ichneumon disparis: Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 85, 239. "Reared in Lab."

Lymantrichneumon disparis: Heinrich, 1968. Ent. Tidskr., 89: 104-105. Europe.

This species was the first ichneumonid parasite described from the gypsy moth. It has been reared several times in Europe and there are several synonyms of it, which are given by Dalla Torre (1901-02) and Uchida (1941). Those synonyms that have appeared in the gypsy moth literature are: *Ichneumon flavatorius* Fabricius, *Trogus flavatorius* Panzer, *Ichneumon ventralis* Matsumura, *Protichneumon disparis orientalis* Heinrich, *Protichneumon disparis matsumurai* Uchida, and *P. disparis segmentalia* Uchida. This species has also been put under various genera, like *Amblyteles*, *Ichneumon*, *Coelichneumon*, *Protichneumon*, and lately under *Lymantrichneumon*.

Face with scattered punctures, extending to base of clypeus. Clypeus smooth and shiny on apical half, with only a few sparse punctures. In female central area of face more densely punctate. Apical margin of clypeus weakly indented medially. Mandible apically tapering, its lower tooth small, less than half as long as the upper tooth. Vertex, upper areas of frons and upper temples with shallow scattered punctures. Antennal scrobes smooth and shiny, frons just in front of median ocelli trans-striate. Area between lateral ocelli and occipital carina closely irregularly punctate. Ocellocular space granulose and a little longer (10: 9) than the interocellar space, which is smoother. Ocelli in male a little raised. Temple wide medially, a little wider than the diameter of eye in side view. Mesoscutum closely ruguloso-punctate. Scutellum subconvex, punctate, carinate laterally only at base, the carina blunt. Apex of scutellum elevated from metascutellum and not in the same plane. Metascutellum subpolished, with a few scattered punctures. Mesopleurum and metapleurum with larger punctures, which are often aciculate at places, particularly in female. Propodeum rugose, areola and basal area subpolished. Areola semicircular or oval, with its apical closing carina arched inwards. Petiolar area concave and abruptly sloping from areola. Median longitudinal carinae bounding petiolar area more or less parallel-sided. Lateral longitudinal carina indistinct so that second lateral area and second pleural area confluent. Spiracular area not separated from second pleural area. Postpetiole flat, widened, its median area raised, like a low pyramid, and striato-punctate. Its sides with irregularly coalescent punctures. Abdomen longitudinally striato-punctate. Gastrocoeli deep and wide, space between them less than their width (0.7) and aciculate. Abdomen of female acute at apex.

Yellowish-brown. Orbits yellow. Flagellum dark brown basally and black apically. Tip of abdomen (tergites 5 and beyond) black. Wings pale yellowish-brown.

Variations: Body often narrow with blackish marks on mesoscutum, meso-

pleurum, metapleurum, apex of propodeum, and hind femur. In the Japanese forms described as *segmentalia*, the thorax is more extensively black and in the form *matsumurai*, the thorax, abdomen, hind femur and hind coxa are largely black.

Length: 15-17 mm. Fore wing 11-12 mm.

Specimens: Several males and females reared from the gypsy moth seen from Italy, Hungary, and Austria.

Distribution: Europe.

Hosts: *Lymantria dispar*, *L. monacha*, *L. dissoluta*, *Leucoma salicis*, *Orgyia antiqua*, *Mimas tiliae*, and *Smerinthus ocellatas*.

2. Genus PARACOELICHNEUMON

Paracoelichneumon Heinrich, 1978. Eastern Palaearctic Ichneumoninae (in Russian). Acad. Sci. USSR., p. 13.

Mandible narrowed apically, but not twisted so that both the teeth are in the same plane. Lower tooth blunt and short. Scutellum flat, in line with metascutellum, shiny and with scattered punctures. Mesopleurum with well formed, often evenly spaced punctures, not coarsely punctate. Areola elongate, rugose, extending up to basal 0.3 of propodeum. Petiolar area abruptly sloping, not concave. Mesoepisternum without a knob-like elevation near hind coxa and in profile view not appearing concave at its margin with mesosternum (*cf. Protichneumon*). Gastrocoeli deep and wide, space between them less than 0.7 their width, and rugoso-striate. Postpetiole rugose. Abdomen closely punctate, in female acute apically.

Paracoelichneumon is rather close to *Lymantrichneumon* and is distinguished by its flat and more polished scutellum, areola, rugose, postpetiole not pyramidally raised, and by its clear hyaline wings. The body is black with the legs and abdomen reddish.

1. PARACOELICHNEUMON RUBENS (Fonscolombe)

Ichneumon rubens Fonscolombe, 1847. Ann. Soc. Ent. France, (2) 5: 407. Europe.

"*Ichneumon rubens* Wesmael": Rudow, 1918. Ent. Ztschr. Frankfurt, 32: 72. Hosts: *Cerura vinula*, *Lymantria dispar*.

Protichneumon rubens: Györfi, 1963. Különl Allattani Kozlem, p. 50-53. Host: *Lymantria dispar* (of minor importance).

Paracoelichneumon rubens: Heinrich, 1978. Eastern Palaearctic Ichneumoninae (in Russian), Acad. Sci. USSR, p. 14.

This species has been referred to as *Ichneumon rubens* Wesmael in the gypsy moth literature (Stadler, 1933, Schedl, 1936). It was apparently first associated with the gypsy moth by Rudow (1918). Györfi (1963) mentioned having reared it in Hungary from the same host. Other host records in literature are of *Cerura vinula* and *Catocala elocata* in Europe.

Flagellum of the female a little widened and ventrally flattened preapically. Face punctate, punctures denser in the median area. Clypeus with scattered punctures at base, smoother apically, its apical margin arcuate. Malar space 0.85 as long as basal width of mandible. Mesoscutum subpolished, with

scattered but definite punctures. Scutellum flat, polished and with scattered punctures. Apex of scutellum in level with the metascutellum. Mesopleurum with distinct large punctures, well separated from each other, by at least their diameter. Metapleurum striato-punctate. Propodeum rugose. Petiolar area and third lateral area trans-rugose. Postpetiole rugulose, its median area weakly defined. Abdomen regularly punctate. Gastrocoeli wide and deep, interspace between gastrocoeli 0.7 their width. Apex of female abdomen acute.

Black with reddish abdomen. Vertical orbits, scutellum, subtegular ridge and a median band on flagellum yellow. Frontal orbits finely marked with brown. Hind corner of pronotum and tegula brown to brownish-black. All coxae and trochanters black. Hind tarsus brownish-black. Legs otherwise reddish (brick-red) with apices of hind femur and tibia blackish. Abdomen from second segment onwards reddish. Wings hyaline, very slightly infuscated.

Length: 20 mm. Fore wing 14 mm.

Specimens: One female from Rumania in the Townes Collection examined. No reared specimens seen.

Distribution: Europe.

3. Genus CALLAJOPPA

Callajoppa Cameron, 1903. Entomologist, 36: 236.

The genus *Callajoppa* is characterized by having the mandible not tapered apically, its lower tooth about 0.5 as long as the upper, occipital carina joining hypostomal carina before the base of mandible, female flagellum widened preapically, scutellum pyramidal, without sharp angles, areola in the form of a polished raised 'boss', somewhat pyramidal in profile, postpetiole flat and with scattered punctures, gastrocoeli shallow, with the interspace between them as wide or wider than the width of a gastrocoelus, and apex of female abdomen obtuse.

Only one species, *Callajoppa cirrogaster cirrogaster* (Schrank) is associated with the gypsy moth. This has generally been referred to as *Ichneumon lutorius* or *Trogus lutorius*.

1. CALLAJOPPA CIRROGASTER CIRROGASTER (Schrank) (Figs. 91-94)

Ichneumon cirrogaster Schrank, 1781. Eunmeratio Insectorum Austriae. Indigenorum, p. 348. Europe.

Ichneumon lutorius Fabricius, 1787. Mantissa Insectorum. . . , 1: 262. Italy.

Trogus lutorius: Močsary, 1787. Tijdschr. Ent., 21: 198. Russia.

"*Trogus flavitorius* [sic] *lutorius* (Fab.)?": Howard and Fiske, 1911. U.S.D.A. Bur. Ent. Bull., 91: 85. Host: *Lymantria dispar*. Europe.

Trogus lutorius: Meyer, 1933. Tables systematiques des hyménoptères parasites (fam. Ichneumonidae) de l'URSS et des pays limitrophes, 1: 345. Russia. Europe. Hosts: *Papilio machaon*, *Dendrolimus pini*, *Lymantria dispar*.

Callajoppa cirrogaster cirrogaster: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 539. Europe. Russia.

This species was first mentioned as a parasite of the gypsy moth by Howard and Fiske (1911, reference cited above), based upon the information they had on their card file as well as from Dalla Torre (1901-02). No such host record is, however, seen in Dalla Torre under "*lutorius*". Other persons who reported this species as a parasite of the gypsy moth are Meyer (1933) and subsequent catalogers like Stadler, Schedl and Thompson. Townes, Momoi and Townes considered *Trogus lutorius* as a synonym of *Callajoppa cirrogaster cirrogaster*.

A subspecies, *C. cirrogaster bilineata* Cameron occurs in China and Japan. Its hosts are species of *Laothoe*, *Smerinthus*, and *Dendrolimus*. *C. cirrogaster caspica* Heinrich occurs in Iran and Transcaucasia.

Face and clypeus punctate. Punctures coalescing in the median area of face. Malar space ruguloso-mat, 1.15 as long as basal width of mandible. Antennal scrobes concave and polished. Vertex concave behind. Temple widened medially. Female flagellum a little indented preapically and then tapering. Mesoscutum finely punctate on a mat surface. Scutellum subpolished pyramidal, without lateral margins or angles. Side of thorax largely punctato-striate. Upper half of pronotum and mesopleurum punctate. Propodeum with areola in the form of a polished elevated "boss", whence with a straight slope to the abdominal attachment. Costula, and median and lateral longitudinal carinae strong and raised. Propodeum strongly transcarinate, especially in the female. Petiole long, narrow and squarish in cross section. Postpetiole wide and flat, weakly punctate, its median field not sharply demarcated. Abdomen finely punctate, obtuse apically. Gastrocoeli shallow and broad, the interspace between them as wide as the width of gastrocoeli and aciculate.

Black with yellowish-brown abdomen. Face, clypeus, mandible except teeth, lower temple, inner and outer orbital borders, and ocellocular area yellowish-brown. Frons, ocellar patch, vertex and temple posteriorly, and occiput, black. The extent of yellowish-brown on outer orbits variable and in some males may not be connected to inner orbits dorsally. Antenna yellowish-brown. Thorax black with yellow marks on upper part of pronotal collar, upper margin of pronotum, hind corner of pronotum, tegula, subtegular ridge, scutellum, metascutellum, and a mark along lateral carina of scutellum. Mesoscutum sometimes with a reddish-brown mark. Legs brownish, with all coxae black, and fore coxa yellowish apically. Hind femur with blackish marks. Tarsi lighter in color. Wings yellowish-brown. Petiole blackish basally. Apex of abdomen black or brown.

Length: 22-24 mm. Fore wing 16-18 mm.

Specimens from Europe seen in the Townes Collection, ex pupa of "*Amorpha tremulae*".

Distribution: Eurasia.

Hosts: *Lymantria dispar*, *Papilio machaon*, *Dendrolimus pini* and *Amorpha tremulae*. Thompson (1957) lists several others belonging to the family Sphingidae.

4. Genus *ICHNEUMON* (Fig. 114)

Ichneumon Linnaeus, 1758. Systema Naturae, (Ed. 10), 1: 560.
= *Coelichneumon* of authors.

This genus is characterized by having a bristle-shaped flagellum, more or less widened preapically in the female, apical margin of clypeus arcuate or truncate, a little impressed, occipital carina joining hypostomal carina, man-

dible moderately narrowed apically, propodeum convex on basal half or less, areola usually horse-shoe shaped or hexagonal, often confluent with basal area, not raised above the general surface of propodeum, abdomen spindle-shaped, a little narrower than the thorax, black or bluish-black, with or without white spots. Postpetiole usually with a distinct aciculate median area, and gastrocoeli large and deep, sometimes wider than the space between them. The tip of abdomen in the female is strongly acute, pointed (oxypygous).

Several species of *Ichneumon* have been reported in literature as parasites of the gypsy moth. There appear to be many erroneous records. The identities of some of the species are also not clear. It appears that only *Ichneumon cyaniventris* may be a parasite of the gypsy moth.

1. ICHNEUMON CYANIVENTRIS Wesmael

Ichneumon cyaniventris Wesmael, 1859. Mém. Couronnés Acad. Sci. Belgique, 8: 58. Europe.

Ichneumon cyaniventris Wesm.: Rudow, 1918. Ent. Ztschr. Frankfurt, 32: 59. Europe. Host: *Lymantria dispar*.

Ichneumon cyaniventris Wesmael: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 523. Eurasia, Korea, Japan. Host: *Clostera anastomosis* (in Japan).

This species was listed by Rudow (1918) as a parasite of the gypsy moth, *Lymantria dispar*. He did not list it in 1911 in his list of parasites of various "Bombycidae". Subsequent catalogers have somehow missed this and some other species listed by Rudow.

This species is rather closely related to *Ichneumon sugillatorius* L. from *Lymantria monacha*. Both have similar color patterns with white spots on abdominal tergites. The face of male is white with a wide black vertical line, which is wider in *cyaniventris* than in *sugillatorius*. The areola of *cyaniventris* is flat and propodeum a little sloping, while in *sugillatorius*, the areola is a little raised and propodeum convex in this area.

Ichneumon leucocerus Gravenhorst is different in having no white spots on the abdomen and the propodeum convex in the region of areola. The areola is crescentic, narrower than in *cyaniventris* or *sugillatorius*.

Some of the salient features of this species are:

Face and clypeus punctate. Clypeus flat and a little arcuate apically. Sub-apical segments of female flagellum a little widened and flattened ventrally. Flagellum apically tapered. Mandible apically not strongly tapered. Thorax punctate. Scutellum flat, shiny, with scattered punctures. Areola horse-shoe shaped, a little wider than long, its apical closing carina concave. Propodeum rugose or rugoso-punctate, with areola smoother. Propodeum in the region of areola flatter and sloping or in male a little convex. Postpetiole aciculate. Petiole laterally margined and trans-striate. Second tergite medially aciculate, rest punctate to striato-punctate. Gastrocoeli deep. Thyridia wide, their interspace 0.7 the width of each thyridium. Abdomen apically acute, punctate, punctures progressively smoother apically.

Black. Face of male white laterally, rather broadly so. Flagellum with about five medial segments wholly or partly white. Scutellum yellow. Tergites 2-3 in ♀ and 2-4 in male with apicolateral white spots. Fore tibia with a yellowish-brown line. In male fore and middle legs from apex of femur onwards brownish, or with yellowish-brown patches. Thorax of male with yellow

marks along upper margin of pronotum, on tegula and on subtegular ridge.

Length: 15-16 mm. Fore wing 11 to 12 mm.

Specimens from Germany seen in the Townes Collection, but no reared specimens were available.

Distribution: Eurasia, Japan and Korea.

2. ICHNEUMON LEUCOCERUS Gravenhorst

Thompson (1946) listed this species as a parasite of *Lymantria dispar* quoting Stadler (1933) and Schedl (1936) from Europe and North Africa. Stadler (1933: 30) however mentioned "*Ichneumon leucocherrus* Wesmael" as a parasite of *Lymantria dispar*, and not *Ichneumon leucocerus* Gravenhorst, which was quoted as such by Schedl (1936). How the record got converted into *leucocerus* is not clear.

"*Ichneumon leucocherrus* Wesm." is not listed in Dalla Torre (1901-02), nor could I find this name in any other publication. It was obviously a *lapsus*, not for *Ichneumon leucocerus* Gravenhorst as Thompson apparently thought, but for *Ichneumon leucocheilus* Wesmael as this latter species was reported parasitic upon *Lymantria dispar* by Rudow (1918).

Ichneumon leucocheilus Wesmael properly belongs to the genus *Melanichneumon* (authentic specimens not available).

Ichneumon leucocerus Gravenhorst is to be removed from the list of parasites of the gypsy moth.

3. "ICHNEUMON PICTUS Gmelin"

Ichneumon pictus Gmelin, 1790. In Linnaeus: Syst. Nat., Ed 13,1(5): 2721.

Ichneumon pictus Gmelin: Dalla Torre, 1901-02. Catalogus Hymenopterorum, 3: 968. Eurasia (in part).

The identity of this species is uncertain. In fact Gmelin (1790. *Systema Naturae*) described two "*Ichneumon pictus*", --one on page 2702 and another on p. 2721. The one described on page 2702 was synonymized under *Microcryptus sericans* (Gravenhorst) (Gelinae) by Dalla Torre (1901-02: 708). The other, described on page 2721, was considered by Dalla Torre (1901-02: 968) to be a senior synonym as well as a homonym of *Ichneumon pictus* Gravenhorst (1829: 418)[which was actually described as *Hoplismenus pictus* Gravenhorst].

A perusal of the original descriptions of the above two species indicates that they are not synonymous.

Hoplismenus pictus Gravenhorst is *Stenobius pictus* (Gravenhorst) vide Rasnitsyn (1981: 132) and Kaspayran (1981: 580). The identity of "*Ichneumon pictus* Gmelin, 1790: 2721" can not now be established. Subsequent workers have overlooked this species. It is incidentally a junior primary homonym of *Ichneumon pictus* Schrank, 1776, as well as a homonym of *Ichneumon pictus* Gmelin 1790: 2702.

Berthoumieu (1895), in his treatment of the European Ichneumonidae did not mention *I. pictus* of Gmelin. He mentioned *I. pictus* Gravenhorst (= *rufescens* Stephens = *ratzeburgi* Hartig) and mentioned *Lymantria dispar* as a host of it upon the authority of Mocsáry (1885). Mocsáry's references could not be located.

Ichneumon pictus Gmelin, should therefore be removed from the list of the

parasites of the gypsy moth.

Ichneumon pictus (Gravenhorst) is treated here under *Stenaoplus*. Records of *Ichneumon pictus* Gmelin as a parasite of *Lymantria dispar*, as given by Stadler (1933), Schedl (1936) and by Thompson (1946, p. 495), should be construed to belong to *Stenaoplus pictus* (Gravenhorst).

The entry in Thompson (1946, p. 499) as *Stenichneumon pictus* Gmelin also pertains to *Stenaoplus pictus* (Gravenhorst). Thompson cited Morley and Rait-Smith (1933) as his source of information. Morley and Rait-Smith referred to *Stenichneumon pictus* Gravenhorst and not Gmelin, taking the host record from Morley (1903, 1: 49).

4. "ICHNEUMON FLAVUS Rd." Nomen nudum.

"*Ichneumon flavus* Rd.": Rudow, 1918. Ent. Ztschr. Frankfurt, 32: 64.

Europe. Hosts: *Lymantria dispar*, *Cerura vinula*.

"*Ischnus flavus* Rd.": Stadler, 1933. Ent. Anz., 13(2-4): 30.

I could not trace the original description of this species in Rudow's publications, nor in Zoological Record. How the generic name changed from *Ichneumon* to *Ischnus* in subsequent publications of Stadler (1933) and Schedl (1936) is unclear. Thompson (1946) mentioned it as "*Ischnus flavus* Rond."

Rudow apparently intended to describe it as a new species. It is a *nomen nudum*.

5. ICHNEUMON sp.

"*Ichneumon* sp.": Picard, 1921. Progres Agric. Vitic., 76(33): 160-165.

France. Schedl, 1936: 188. Thompson, 1946: 495. Host: *Lymantria dispar*.

The identity of this species will remain uncertain until the voucher specimen is seen, if still available. It could be one of the other *Ichneumonini* treated here.

TRIBE JOPPINI

5. Genus STENAOPLUS

Stenaoplus Heinrich, 1938. Mem. Acad. Malgache, 25: 116.

The genus *Stenaoplus* is characterized by having a moderately to strongly raised scutellum which is laterally sharply margined by carinae up to its apex, flagellum of female long, tapering and slender, not flattened or much widened preapically, propodeum flat on basal half and then sloping, the horizontal portion of propodeum a little shorter than the apical sloping part, apophyses absent, areola normally formed, squarish or elongate, postpetiole granulose to punctate, without a median field, gastrocoeli shallow, weakly impressed, very wide, and narrow, the space between them less than 0.7 their width.

One species, *Stenaoplus pictus* (Gravenhorst) has been mentioned in litera-

ture as a parasite of the gypsy moth.

1. STENAOPLUS PICTUS (Gravenhorst)

Hoplismenus pictus Gravenhorst, 1829. Ichneumonologia Europea, 2: 418.

Ichneumon pictus Gravenhorst: Berthoumieu, 1895. Ann. Soc. Ent. France, 1895, p. 567. (synonymy and host records).

Ichneumon pictus: Dalla Torre, 1901-02, Catalogus Hymenopterorum, 3: 968. (In part). Hosts: *Lymantria dispar* (after Mocsáry), *Thera juniperata*, *Semiothisa liturata*, *Cidaria fulvata*.

Ichneumon rufescens Stephens, 1835. Illustrations to British Entomology, Mandibulata, 7: 207. Name preoccupied by Rossi, 1794 and by Cervier, 1833.

Cryptus Ratzebergii Hartig, 1838. Jahresber. Forstschr. Forstw., 1 (2): 263. Host: *Dendrolimus pini*.

Ichneumon rufescens Stephens: Perkins, 1953. Bull. British Mus. (N.H.) Ent., 3: 112. [= *Aoplus ratzeburgi* (Hartig), syn. *Stenichneumon pictus* (Gravenhorst) Morley.]

Hoplismenus pictus Gravenhorst and *Ichneumon pictus* Gmelin are not primary homonyms and do not belong to the same genus now. Therefore the name *pictus* Gravenhorst is reinstated for *rufescens* Stephens or *ratzeburgi* Hartig, as used in the publications of Perkins (1953, 1960) and Fitton (1978).

Stenaoplus pictus (Gravenhorst) was first reported as a parasite of the gypsy moth by Mocsáry (1885). Berthoumieu (1895) mentioned it in his treatment of the European Ichneumoninae. All the reports of Stadler, (1933), Schedl (1936) and Thompson (1946, p. 495 and 499), pertain to this species. The host records as given by Morley (1903) and others are *Lymantria dispar*, *Cidaria fulvata*, *Semiothisa liturata* and *Thera juniperata*. Kasparyan (1981) mentions these hosts except *Lymantria dispar*—the reason for which is not stated! Perkins (1960) stated that this species is parasitic on geometrids on *Pinus*.

Female: Small sized species. Subapical flagellar segments not conspicuously widened though a little flattened ventrally. Face and clypeus with distinct well separated punctures. Clypeus a little convex basally, its apical margin truncate. Mandible narrowed apically, its lower tooth short and pointed. Malar space about 0.8 as long as the basal width of mandible. Temple not widened medially. Mesoscutum mat, with shallow punctures. Scutellum subconvex, laterally carinate and with scattered minute punctures. Mesopleurum and metapleurum punctate. Areola horse-shoe shaped, as long as wide, subpolished, mat. Petiolar area concave. Postpetiole mat. Tergites 2 and 3 with definite regular punctures. Thyridia wide, about 2.0 as wide as the space between them. Ovipositor rather long for the group, as long as or longer than the maximum width of abdomen (apical width of tergite 2).

Brownish-yellow. Frontal and vertical orbits yellow marked. Frons, vertex, occiput and antenna blackish-brown. Apex of scutellum, metascutellum, and subtegular ridge yellow-marked. Propodeum blackish. Coxae brownish with dorso-apical blackish marks. Hind tibia and tarsus with fuscous spots. Abdomen brownish-yellow, without any white apical marks.

Male: Face strongly punctate. Body conspicuously marked with red and yellow. Inner orbits yellow. All femora reddish. Hind tibia without a yellow median band. Coxae usually marked with yellow and red.

Length: 6-10 mm. Fore wing 4.5-6.5 mm.

Specimens: England, 1♀, det. Perkins, 1953 (Townes). No reared specimens seen.

Perkins (1960) puts the species under *Aoplus* as *ratzeburgii* (Hartig) and provides a key to distinguish it from the other British species.

6. Genus MELANICHNEUMON (Fig. 115)

Melanichneumon Thomson, 1893. Opuscula Entomologica, 18: 1954.

The genus *Melanichneumon* is characterized by having the subapical flagellar segments of the female very wide and flat ventrally, the widest segments about 2.0 as wide as long. Male flagellum with transverse ridges ventrolaterally which are beset with short bristles. Base of propodeum with a small median tubercle. Areola more or less horse-shoe shaped, narrowed towards base. Propodeal carination sharp and of a generalized type. Abdominal tergites 2-3 strongly neatly punctured and convex. Postpetiole also punctate, not striate. Thyridia weakly impressed, the space between them more than 1.5 the width of a thyridium. Apex of female abdomen oxypygous, and usually yellow or white.

One species of this genus has been mentioned as a parasite of the gypsy moth, under the name *Ichneumon leucocheilus* Wesmael.

1. MALANICHNEUMON LEUCOCHEILUS (Wesmael) (Figs. 95, 96)

Ichneumon leucocheilus Wesmael, 1844. Nouv. Mem. Acad. Sci. Bouxelles, 18: 89. Europe.

Ichneumon leucocheilus Wesm.: Rudow, 1918. Ent. Ztschr., 32: 64. Europe. Host: *Lymantria dispar*.

Melanichneumon leucocheilus: Perkins, 1960. Handbook for the identification of British Insects, 7(2): 150. England.

The earliest reference to this species being parasitic upon *Lymantria dispar* was traced to Rudow (1918).

'*Ichneumon leucocherrus* Wesm.' as quoted by Stadler (1933) and Schedl (1936) is definitely a lapsus for *I. leucocheilus* Wesm. No species as '*Ichneumon leucocherrus* Wesm.' exists. Thompson (1946) erroneously reported it as '*Ichneumon leucocerus* Gravenhorst.'

Specimens of this species were not available for study. The following description is taken from Berthoumieu (1895) and Perkins (1960):

Clypeus with a weak, rather broad, central projection. Areola sub-hexagonal, elongate. Legs robust. Postpetiole punctate. Gastrocoelus small and superficial. Thyridium indistinct. Occipital carina meeting hypostomal carina near base of mandible.

Female: Antenna with a white annulus. Head and thorax wholly black. Wings hyaline. Stigma black. Tegula reddish-brown. Legs reddish-brown with coxae black. Hind femur and tibia brown. Abdominal segments 2-4 and base of 5, reddish-brown. 6-7 segments white. Tip of abdomen white.

Male: Facial orbits white. Antenna black, ferruginous basally. Wings a little infusate. Coxae and trochanters black. Rest of fore and middle legs red, with white or fuscous patches. Hind femur infusate, tibia and tarsus black. Abdomen black with apex of tergites 1-3 red. Tergite 7 with a large

dorsal white spot.

Length: 10-13 mm.

Distribution: Europe.

7. Genus CRATICHNEUMON (Fig. 117)

Cratichneumon Thomson, 1893. Opuscula Entomologica, 18: 1945.

Female flagellum cylindrical and blunt apically, only a little widened pre-apically. Occipital carina joining hypostomal carina at a distance equal to 0.35 the basal width of mandible. Scutellum flat, not carinate laterally. Median part of propodeum without a weak tubercle in the middle, its dorsal surface flat, and petiolar area excavated. Postpetiole with shallow punctures, or its median area with only fine striations and not sharply demarcated from the lateral areas. Gastrocoeli weak, superficial. Thyridia linear, smaller than the distance between them. Abdomen oxygygous.

Cratichneumon is close to *Melanichneumon*. Species of *Cratichneumon* are more smooth and shiny, with less densely punctate mesoscutum and abdomen, shallower gastrocoeli, which are often obsolete, and abdominal tip is rarely white marked.

Members of this genus are generally parasitic upon geometrid pupae. The females do not hibernate and many species have two generations per year, adults appearing in May-June and again in August. One species, *Ichneumon fabricator*, is reported in the literature as a parasite of the gypsy moth.

1. CRATICHNEUMON FABRICATOR (Fabricius) (Fig. 97, 98)

Ichneumon fabricator Fabricius, 1793. Entomologica Systematica, 2: 166. Germany.

Ichneumon fabricator F.: Schedl, 1936. Monogr. Angew. Ent., 12: 188. Europe. Hosts (after Cecconi, 1924): *Lymantria dispar*, *Elkneria pudibunda*, *Panolis flammea*, *Bupalus piniaria*, *Operophtera brumata*.

Protichneumon fabricator: Györfi, 1963. Különyömet az állattani Közlemények L. Kötet, 1-4: 51. Hungary. Not common. Host: *Lymantria dispar*.

Cratichneumon fabricator: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 442. Eurasia.

Cratichneumon fabricator: Kasparyan, 1981. Fauna USSR, Vol 3 (Ichneumonidae): 573. Eurasia. Hosts: *Semiothisa liturata*, *Bupalus piniaria*, *Rhyacionia pinicolana*, *Notodonta dromedarius*, *Elkneria pudibunda*, *Panolis flammea*, and *Tethea or*.

This species was first reported from *Lymantria dispar* by Cecconi (1924). Kasparyan (1981) listed several hosts in European USSR, but did not mention *Lymantria dispar*.

Female: Flagellum cylindrical and blunt apically, only a little widened pre-apically. Face a little convex below antennal sockets. With well separated punctures. Clypeus polished, with rows of punctures at base and with a few scattered punctures in the middle. Temple wider ventrally. Malar space equal to the basal width of mandible. Frons and vertex mat, with scattered punctures. Vertex widened behind eyes. Thorax punctate, the mesoscutum

shallowly so and propleurum more densely so. Scutellum flat, subpolished and with scattered punctures. Propodeum flat dorsally, its petiolar area excavated. Lateral carinae of areola indistinct basally. Median field of postpetiole not sharply demarcated, with fine weak striations interposed with punctures. Tergite 2 punctate. Width of thyridia less than the distance between them. Tergite 3 with shallow, indistinct punctures.

Black. Flagellum with a white annulus. Tegula brownish-black. All coxae and trochanters black, femora brown, tibiae brown with white marks and tarsi brown. Hind tibia apically and tarsus darker, brownish-black. Wings hyaline, a little brown-tinged.

Male: Flagellum tapered, somewhat serrate. Propodeal carinae stronger. Postpetiole without striations. Gastrocoeli deeper.

Face and clypeus largely white. Face with a black central mark. Flagellum brownish below, without a white annulus. Hind corner of pronotum and subtegular ridge yellow. Fore and middle femora, tibiae and tarsi orange colored. Hind leg wholly brownish-black.

Length: 8-11 mm. Fore wing 7-8 mm.

Specimens from Europe examined in the Townes Collections. No reared specimen seen. Several host records are mentioned by Thompson (1957).

Distribution: Europe.

8. Genus CHASMIAS (Fig. 118)

Chasmias Ashmead, 1900. Proc. U. S. Natl. Mus., 23: 17.

Apical margin of clypeus broadly weakly concave, with a weak broad median tooth. Mandible not much narrowed apically, its lower tooth shorter than the upper. Occipital carina joining hypostomal carina above the base of mandible. Antennal flagellum cylindric in the female and somewhat serrate in the male. Preapical segments not flattened. Tip of female flagellum blunt and apical segments curled. Areola horse-shoe shaped, open behind, elongate in female. Abdomen oxypygous. Postpetiole with a weak median field, which is weakly striate. Gastrocoeli small to large, shallow. Ovipositor distinctly exerted beyond the tip of abdomen.

One species, *Chasmodes paludicola*, was reported by Rudow (1917) as a parasite of the gypsy moth in Europe.

1. CHASMIAS PALUDATOR (Desvignes)

Ichneumon paludator Desvignes, 1854. Trans. Roy. Ent. Soc. London, (N.S.) 3: 44. England.

Chasmodes paludicola Wesmael, 1857. Bull. Acad. Sci. Belgique, (2)2: 356. Europe.

Chasmias paludicola: Dalla Torre, 1901-02. Catalogus Hymenopterorum, 3: 1024.

Chasmodes paludicola: Rudow, 1917, Ent. Ztschr. Frankfurt, 31: 31.

Host: *Lymantria dispar*.

Heinrich (1937) synonymized *Chasmodes paludicola* with *paludator*. Rudow's record was missed by Schedl, Thompson and others.

Female: Face with distinct well separated punctures, interspaces 1.0 to

1.5 the diameter of the punctures and shiny. Thorax punctate. Punctures on mesoscutum small and shallow. Scutellum flat, subpolished. Areola horse-shoe shaped, open behind, elongate in the female. Median field of postpetiole very finely striate. Gastrocoeli small. Tergites 2 and 3 finely punctate. Ovipositor extending conspicuously beyond the tip of abdomen.

Black. Flagellum medially and scutellum yellow. Coxae black. Legs otherwise reddish-brown, with tarsi infusate. Tergites 1, 2, and 3 reddish-brown, the rest black. Tergite 7 with an elongate yellowish-brown longitudinal stripe.

Male: Punctures stronger over body. Flagellum tapered and weakly serrate. Areola more squarish and widely open behind.

Black. Facial orbits narrowly yellow. Scutellum black. All femora, and tibiae reddish-brown, tarsi infusate. Tergite 2 largely reddish-brown, with black patches, rest of abdomen black.

Length: 15-17 mm. Fore wing 12-14 mm.

Specimens from Europe examined in the Townes Collections. No reared specimens seen.

Distribution: Europe.

9. Genus PTEROCORMUS (Fig. 120)

Pterocormus Foerster, 1850. Arch. f. Naturgesch., 16: 71.
= *Ichneumon* of authors.

A genus close to *Chasmias*, but apical margin of clypeus truncate, or weakly convex, without a median tooth, apical part of female flagellum more or less tapered, thyridia moderately large and distinctly impressed and median fold on sternite 4 rather distinct.

One species, *Ichneumon sarcitorius* was recorded by Meyer (1929) as a parasite of the gypsy moth in Russia.

1. PTEROCORMUS SARCITORIUS SARCITORIUS (Linnaeus) (Figs. 99, 113, 120)

Ichneumon sarcitorius Linnaeus, 1758. Systema Naturae, (Ed 10) 1: 561.
Europe.

Meyer, 1929. Rpts. Sppl. Ent., Bur. Appl. Ent., State Inst. Exper. Agron, Leningrad, 4: 240. Host: *Lymantria dispar*. USSR.

Pterocormus sarcitorius sarcitorius: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 479. Syn. references, host records. Eurasia. North Africa.

Female: Face punctate, interspaces shiny. Flagellum cylindrical, apical segments tapering and weakly curled. Thorax punctate. Scutellum flat and subpolished. Punctures on meso- and metapleurum becoming rugose at places. Propodeum ruguloso-punctate. Areola squarish, open behind. Median field of postpetiole clearly demarcated and finely longitudinally striate. Gastrocoeli small but deep. Tergite 2 and 3 moderately deeply punctate. Sternites 2-5 with a midventral fold. Ovipositor slightly exerted beyond abdominal tip.

Black. Frontal orbits, and tegula brown. Median flagellar segments, subtegular ridge and scutellum yellow. All coxae, trochanters and apices of hind femur and tibia black. Legs otherwise reddish-brown. Tergite 2 wholly

and tergite 3 in apical 0.6 reddish-brown. Sternites 2 and 3 yellowish-brown. Tergite 6 broadly yellow dorsally.

Male: Face, clypeus and scape ventrally yellow. Clypeus and face triangularly above clypeus may be black. Antenna brown, darker dorsally. Tegula, subtegular ridge and scutellum, yellow. Hind corner of pronotum also often yellow. Apices of abdominal tergites yellow, these yellow marks widened laterally. Those on tergites 1 and 4 usually incomplete dorsally, and absent on tergite 5.

Length: 12-16 mm. Fore wing 9-12 mm.

Specimens from Europe examined in the Townes Collections. No reared specimens seen.

Distribution: Eurasia, China, North Africa.

Hosts: *Lymantria dispar*, *Diloba caeruleocephala*, *Gortyna borelli*, and *Agrotis segetum*.

10. Genus TRIPTOGNATHUS (Fig. 119)

Triptognathus Berthoumieu, 1904. *Genera Insectorum*, 18: 49.

Female flagellum short, curled, its second segment 0.8 to 1.4 as long as wide, its apex with a short taper. Flagellum of male slender. Mandible not tapered apically, only slightly narrowed apically. Occipital carina joining hypostomal carina above base of mandible. Areola about 1.0 as long as wide. Abdomen amblypygous, its tip rounded. Side of median field of postpetiole sharply defined. Gastrocoeli small to large, shallow to moderately deep, with a distinct thyridium. Sternite 3 with its median 0.3 or more membranous, visible as a longitudinal fold in dried specimens. Sternite 4 not membranous medially. Ovipositor unusually short. Female subgenital plate conspicuous. Male subgenital plate with a rather long median apical lobe. Genital claspers unusually large, in profile view the lower apical corner more produced and pointed than the upper.

One species, *Triptognathus amatorius* (Mueller), is associated with the gypsy moth.

1. TRIPTOGNATHUS AMATORIUS (Mueller) (Figs. 100-103)

Ichneumon amatorius Mueller, 1776. *Zoologicae Danicae Prodrum*, p. 151. Denmark.

Amblyteles amatorius: Rudow, 1917. *Ent. Ztschr. Frankfurt*, 31: 26. Europe. Hosts: *Lymantria dispar*, *L. monacha*.

Amblyteles amatorius: Uchida, 1926. *J. Fac. Agr. Hokkaido Imp. Univ.*, 18: 118. Sakhalin. Hosts: *Lymantria dispar*, *L. monacha*, *Anaplectoides virens*, *Dendrolimus albolineatus*.

Triptognathus amatoria: Townes, Momoi and Townes, 1965. *Mem. Amer. Ent. Inst.*, 5: 496. Europe, Japan, Russia, Sakhalin.

Diphyus amatorius: Kasparyan, 1981. *Fauna USSR, Ichneumonidae*, 3: 614, 616, 617, 618. Russia.

This species was not listed as a gypsy moth parasite by Schedl (1936) or Thompson (1946). The earliest record of its occurrence on the gypsy moth is that of Rudow (1917) in Europe and Uchida (1926) in Sakhalin.

Female: Face densely punctate. Mesoscutum closely finely punctate. Scutellum flat, subpolished with shallow indistinct punctures. Mesopleurum and metapleurum densely punctate, punctures on metapleurum finer than those on mesopleurum. Propodeum densely finely punctate. Areola rectangular, open behind. Costula indistinct. Apophyses indistinct. Median field of postpetiole longitudinally striate. Postpetiole punctate apicolaterally. Tergites 2 and 3 very finely and closely punctate. Gastrocoeli weakly impressed, rather indistinct, their width less than the space between them. Ovipositor hardly exerted.

Black. Inner orbits, flagellum medially, hind corner of pronotum, subtegular ridge and scutellum yellow. Apices of abdominal tergites yellow. Tergite 2 orange-red. Sternites 2 and 3 orange-red. Legs black with their femora and tibiae yellowish-brown.

Male: Generally similar to the female but flagellum long and slender, black. Punctures on face more regular and a little larger. Thoracic punctures comparatively larger. Areola squarish, closed behind and gastrocoeli more distinctly impressed. Sternites 2 and 3 with a midventral fold.

Face, clypeus and scape ventrally, yellow. Tegula, subtegular ridge, hind corner of pronotum and scutellum, yellow. Legs as in the female but fore femur wholly, and middle femur largely also yellow. Tergites 2 and 3 yellow. Yellow margins on tergites narrow.

Length: 15-18 mm. Fore wing 12-15 mm.

Specimens from Europe seen in the Townes Collection. No reared specimens seen.

Distribution: Eurasia.

11. Genus SPILICHNEUMON (Fig. 116)

Spilichneumon Thomson, 1894. Opuscula Entomologica, 19: 2087.

Female flagellum short, curled, its second segment about 1.4 to 1.8 as long as wide, its apex with a short taper. Mandible wide, apically, in male gradually tapered. Male flagellum with a long taper. Areola about 1.4 (male) or 1.8 (female) as long as wide. Apical half of postpetiole with the median field indistinctly bounded laterally. Abdomen amblypygous. Ovipositor unusually short. Sternite 4 often not membranous medially. Subgenital plate of male and female and male claspers as in *Triptognathus*.

One species, *Ichneumon occisor* Fabricius, was listed by Rudow (1917) as a parasite of the gypsy moth in Europe.

1. SPILICHNEUMON OCCISOR (Fabricius) (Figs. 104-110, 116)

Ichneumon occisor Fabricius, 1793. Ent. System., 2: 142. Europe.

Ichneumon occisorius Fabricius, 1804. System. Piez., p. 61.

Emendation.

Amblyteles occisorius Wesm: Rudow, 1917. Ent. Ztschr. Frankfurt, 31: 26. Hosts: *Lymantria dispar*, *Leucoma salicis*.

Spilichneumon occisor: Townes, Momoi and Townes, 1965: 504.

(= *occisorius* Grav. = *occisor* Fabr.)

Rudow (1917) apparently first recorded it as a parasite of *Lymantria*.

dispar. Subsequent cataloguers have missed this species in their lists.

This species resembles *Triptognathus amatorius* and *Pterocormus sarcitorius* in general appearance, but it can be readily separated from them by the characters given in the keys above.

Female: Face with minute well formed punctures, interspaces shiny. Clypeus rather flat. Mandible a little wider preapically. Thorax punctate with mesoscutum finely so and largely shiny. Scutellum polished. Propodeum finely ruguloso-punctate. Areola elongate and narrow, rounded basally. Post-petiole finely aciculate in the median field, polished otherwise. Tergites 2 and 3 very finely and shallowly punctate and shiny. Sternites 2 and 3 with a median fold.

Black. Frontal orbits and mandible reddish-brown. Flagellum yellowish-brown subapically. Subtegular ridge yellow. Scutellum yellow. Tergites and sternites 2 and 3 orange-red. Other tergites yellow medially along their apical margins, these stripes incomplete. Legs blackish-brown with tibiae and tarsi lighter in color.

Male: Face, clypeus, mandible medially, and underside of scape, yellow. Tegula, subtegular ridge, hind corner of pronotum and scutellum, yellow. Legs yellow with all coxae and trochanters and hind femur black. Apex of hind tibia black. Abdomen black with tergites 2 and 3 largely and apices of the following tergites, yellow. Last tergite largely yellow. Only sternite 2 with a median fold.

Length: 12-15 mm. Fore wing 8-10 mm.

Specimens from Europe in the Townes Collection examined. No reared specimens seen.

Distribution: Europe.

12. Genus AMBLYTELES

Amblyteles Wesmael, 1844. Nouveaux Mém. Acad. Roy Sci. Lett. Beaux-Arts Belgique, 18: 112.

Apical margin of clypeus truncate, without any tubercle. Lower tooth of mandible small. Occipital carina complete to hypostomal carina. Flagellum long, its second segment 1.4 to 3.0 as long as wide, its apex tapered, median segments cylindric. Propodeum with distinct sublateral triangular projections, one on either side. Abdomen of female amblypygous, its tip blunt. Gastro-coeli small to large. Thyridium small, weakly impressed. Ovipositor unusually short. In the female sternite 4 often membranous medially, and subgenital plate conspicuous and without an apical tuft of hairs. In the male the subgenital plate medially rounded or without a long lobe, and genital claspers not enlarged. Apex of first tergite and propodeum often black.

Amblyteles as defined here contains only one European species, *A. armatorius* (Förster).

Three species, *Amblyteles armatorius*, *A. camelinus* and *A. varipes* have been mentioned in the literature as parasitic upon the gypsy moth in Europe. The record of *A. camelinus* appears erroneous. Neither *camelinus* nor *varipes* belong to *Amblyteles*. Neither of these species have been subsequently reared from the gypsy moth. Reared material even of *A. armatorius* was not available to confirm its occurrence on the gypsy moth.

1. AMBLYTELES ARMATORIUS (Foerster) (Figs. 111, 112)

Ichneumon armatorius Förster, 1771. Novae Species Insectorum. Centuria, 1: 82. England.

Ichneumon fasciatorius Fabricius, 1775. Systema Entomologiae, 330. England.

Amblyteles fasciatorius: Uchida, 1930. J. Fac. Agr. Hokkaido Imp. Univ., 25: 354. Japan. Hosts: *Dendrolimus albolineatus*, *Lymantria dispar*, *L. monacha*.

Amblyteles armatorius: Townes, Momoi and Townes, 1965: 502. Eurasia, Iran, Algeria.

This species has been reported in literature from several hosts in Japan and Europe. Uchida (1930) apparently reported it for the first time from *Lymantria dispar* in Japan. Schedl (1936) and Thompson (1946) do not list it.

This species can be readily distinguished by its black and yellow banded abdomen and propodeum having spine-like projections on either side.

Female: Face closely punctate, punctures coalescing. Clypeus smoother apically, its apical margin truncate or a little arcuate medially. Mandible narrowed apically, lower tooth blunt and much shorter than the upper. Malar space as long as the basal width of mandible. Frons and vertex closely punctato-rugose. Occipital carina meeting hypostomal carina away from mandibular base by a distance equal to the basal width of mandible. Thorax rugosely sculptured. Sculpture of mesoscutum finer than that of rest of thorax. Propodeal areola squarish to a little rectangular, almost touching base of propodeum. Petiolar area depressed and bordered by longitudinal carinae. Lateral projections on propodeum sharp. First tergite, particularly postpetiole, rugose, its median field distinct and with striations. Second and third tergites punctato-rugulose. The following tergites smoother. Gastrocoeli short, carinate, its length about 0.5 the distance between the two. Tip of abdomen blunt, obtuse (amblypygous).

Black, with yellow marks on body and abdomen.

Face with lateral yellow stripes along inner orbits. Flagellum brown, tapering. Pronotal collar dorsally, hind corner of pronotum, tegula, subtegular ridge, and scutellum, yellow. Legs black with extensive yellow marks on trochanters, base, apex and a dorsal line on fore and middle femora, whole of fore and middle tibiae, hind femur in basal 0.25 and hind tibia in basal 0.5. All tarsi brownish, but hind tarsus darker. Abdomen black with yellow stripes on base of second and third tergites, extending laterally, and apex of fourth to sixth tergites. Seventh tergite broadly yellow. Sometimes hind tibia brownish in apical half, rather than black.

Male: Sculpture similar to that of female, but color different as below. Flagellum yellow ventrally. Scape largely yellow. Face and clypeus yellow. Fore and middle legs almost wholly yellow except for dorsal black marks on femora. Hind tibia yellow in basal 0.75. Second tergite yellow in basal 0.6. Third tergite yellow except narrowly apically. Fourth and fifth wholly, and basal half of sixth tergite black. Tip of abdomen yellow.

Length: 13-16 mm. Fore wing 11-13 mm.

Specimens from Europe examined in the Townes Collections. No reared specimens seen. Host records are given by Thompson (1957).

Distribution: Europe. Japan.

2. "AMBLYTELES VARIPES" Rudow.

Amblyteles varipes Rudow, 1888. Entom. Nachr., 14: 86. ♂, ♀.

Germany. Host: *Lymantria dispar*.

Amblyteles variipes: Dalla Torre, 1901-02. Catalogus Hymenopterorum, 3: 843.

Amblyteles varipes: Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 85. Host: *Lymantria dispar*.

This species, somehow, has not been mentioned by any of the subsequent cataloguers of gypsy moth parasites. It is also unknown to me, as no specimens of it were available in the Townes Collections. Berthoumeiu (1894-96) did not include it in his treatment of the European species. The identity of this species is, therefore, uncertain.

A perusal of the original description reveals that it is not a true *Amblyteles* and may belong to *Ichneumon*, *Melanichneumon* or *Ctenichneumon*. It is characterized by having a black body, with antenna, scutellum and hind leg wholly black. The fore and middle legs are rufous and the wings are infumate.

The antenna is said to be serrate underneath (cf. ♂ *Ctenichneumon*), scutellum flat, areola regularly 5-sided (cf. *Ichneumon*) thorax and abdomen ruguloso-punctate and only sternites 1 and 2 with ventral folds (cf. *Ctenichneumon*).

Length: 18 mm.

Host: *Lymantria dispar*.

Distribution: Germany.

3. "AMBLYTELES CAMELINUS Wesmael"

Amblyteles camelinus Wesmael, 1844. Nouveaux Mem. Acad. Sci. Lett. Beaux Arts Belgique, 18: 129. Belgium.

Meyer (1936) mentioned *Lymantria dispar* as one of the hosts of this species. Earlier (1933, Pt 1: 304) he listed "*Pergesa dispar*" as one of the hosts in his treatment of this species. No subsequent worker has reported it as parasitic upon the gypsy moth. This species is a parasite of the pupae of nymphalid butterflies and the record from the gypsy moth is undoubtedly erroneous. Perkins (1953) erected a new genus *Thyrateles* for the reception of this species. Townes *et al.* (1965: 459) synonymized *Thyrateles* under *Pterocormus* Foerster (= *Ichneumon* of authors). Kasparyan (1981: 608) treats this species as *Thyrateles camelinus* Wesmael.

TRIBE PRISTICEROTINI

13. Genus COTIHERESIARCHES (Fig. 121)

Cotiheresiarches Talenga, 1929. Zool. Anz., 83: 185.

This genus is readily distinguished from the others treated here by its petiole being flat dorsally, and wider than deep. The clypeus projects forward and is triangular in outline. Mandible is strong, with only one tooth.

One species *Cotiheresiarches dirus* has been associated with the gypsy moth, which is a robust looking species with a black body and yellow femora.

1. COTIHERESIARCHES DIRUS (Wesmael) (Fig. 121)

Eurylabus dirus Wesmael, 1853. Bull. Acad. Sci. Belgique, 20: 307.

Eurylabus dirus: Dalla Torre, 1901-02. Catalogus Hymenopterorum, 3: 792. Europe. Algeria. Hosts (after several authors):

Trichiura crataegi, *Eriogaster lanestris*, *Orthosia opima*.

Eurylabus dirus: Fahringer, 1922. Z. Angew. Ent., 8: 325-388. Host: *Lymantria dispar*.

Cotiheresiarches dirus: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 513. synonymy.

This species was first reported as a parasite of the gypsy moth by Fahringer (1922). Kolubayiv (in Komarek, 1937) subsequently reported it as a moderately common parasite of the nun moth (*Lymantria monacha*). There is apparently no subsequent rearing record from the gypsy moth.

It is readily distinguished from other Ichneumoninae by its petiole flattened dorsally. This flattened area is carinate laterally. The body is somewhat robustly built and is 14-16 mm. long. The abdomen is obtuse apically.

Face and clypeus closely punctate. Clypeus triangular, with its apical margin curved anteriorly and thus quite distant from the mandibles. Clypeus and face making a concave curve. Mandible tapered apically, with its lower tooth virtually absent. Antennal flagellum not widened medially, apically finely long-tapered. Thorax closely punctate, punctures rough at places. Scutellum convex and punctate. Propodeum rugose. Areola convex, combined first and second lateral areas concave. Propodeal carinae irregular. Petiole flattened dorsally, the flattened area leathery in texture and bordered by blunt carinae. Postpetiole ruguloso-punctate, apically smoother, without a distinct median field. Second tergite rugose medially and punctate on either side. Gastrocoeli moderately deeply impressed, carinate. Thyridium about as wide as the space between them. Third tergite closely finely punctate. The following tergites progressively weakly punctate to mat. Abdomen amblypygous. Female subgenital plate long and V-shaped.

Black. Fore and middle femora, tibiae and tarsi and hind femur orange-red. Hind tibia and tarsus brownish-black, with tarsal segments apically brown. Wings clear hyaline, stigma pale brown, veins darker, brownish-black.

Length: 14 mm. Kolubayiv (1937) mentioned the length as 15-16 mm.

Distribution: Europe.

Specimen: One female seen in the Townes Collection. No reared material seen.

IV. SUBFAMILY MESOSTENINAE

Members of the subfamily Mesosteninae are characterized by having a depressed abdomen, with a moderately long first tergite, with spiracles usually behind the middle and the postpetiole widened posteriorly. Clypeus separate from the face, often convex and its apical margin usually without teeth. Notauli and sternaulus distinct and strongly impressed. Apical truncation of scape strongly oblique. Dorsal rim of metanotum without a small sublateral angular projection, but sometimes with such a projection *just below* the hind margin, and often with a submedian pair of such projections,

one opposite each side of the scutellum. Propodeum with one or two transverse carinae, usually the basal transverse carina alone present or more prominent. Propodeum without longitudinal carinae except rarely. Epiplura of second tergite narrow, often vestigial. Tarsal claws simple. Second recurrent vein with a single bulla, not sloping outwards, meeting subdiscoidal vein at a right angle. Areolet usually present. Ovipositor long, without any subapical notch, with ridges on tip of lower valve.

The subfamily Mesosteninae is the same as tribe Mesostenini in Townes (1970). Gupta (1973) raised it to the subfamily level.

The genera that have been associated with the gypsy moth are believed to be parasitic on the host prepupae or larvae within the cocoons. The egg is laid externally on the body of the host larva or prepupa within the cocoon. Emergence is from the pupa, or from the parasite's cocoon within the cocoon of the gypsy moth.

Five species of Mesosteninae have been recorded as parasites of the gypsy moth, viz., *Cryptus cyanator* Gravenhorst, *C. amoenus* Gravenhorst, *C. liparidis* Rnd., *Ischnus assertorius* Gravenhorst and "*Ischnus flavus* Rnd." (Stadler, 1933). Of these, *Cryptus liparidis* and *Ischnus flavus* are *nomina nuda*. They are mentioned by Rudow (not Rondani as subsequent catalogues give), 1918, as "*Cryptus liparidus* Rd." and "*Ichneumon* [not *Ischnus*] *flavus* Rd." = nov. sp., but apparently he never described them.

Reared specimens of the other species were not available. They have not been encountered during the surveys for gypsy moth parasites in Europe and Asia. Their occurrence on the gypsy moth is either accidental, or more likely, doubtful.

The nomenclature of the species is corrected according to the modern treatment of the group. Townes, Momoi and Townes (1965), Townes (1970), and Kasparyan (1981) may be consulted for synonymies and other taxonomic information.

KEY TO THE GENERA AND SPECIES OF MESOSTENINAE ASSOCIATED WITH THE GYPSY MOTH

1. Intercubitii parallel. Median portion of posterior mesosternal carina present between the middle coxae. Sternaulus short, reaching up to 0.6 the length of mesopleurum, not sinuate. Clypeus a little arched, weakly convex. Basal and apical transverse carinae of propodeum equally prominent. Propodeal spiracle short, circular. First tergite with basolateral teeth. 1. *Gambrus amoenus* (Gravenhorst)
- Intercubitii convergent towards radius. Median portion of posterior mesosternal carina absent or indistinct. Sternaulus reaching middle coxa and sinuate. Clypeus convex. One of the two transverse carinae of propodeum more prominent than the other. 2
2. Propodeal spiracle elongate, elliptic. Apical transverse carina of propodeum strong and strongly arched medially (more prominent than the basal transverse carina). Axillus vein strongly pigmented and diverging from the anal margin of hind wing. Base of first tergite without a lateral tooth. 2. *Meringopus cyanator* (Gravenhorst)
- Propodeal spiracle short, circular. Basal transverse carina of propodeum prominent. Apical carina weak. Axillus vein weakly pigmented and very close and parallel to the anal margin of hind wing. Base of first tergite

with a lateral tooth. 3. Ischnus inquisitorius
inquisitorius (Mueller)

1. Genus GAMBRUS (Fig. 74)

Gambrus Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 188.

Medium sized insects. Clypeus subconvex, its apical margin convex and with a blunt median prominence. Mesoscutum mat and with scattered punctures. Apical carina of propodeum complete, its median portion more or less bowed forwards, the lateral crests weak. Propodeal spiracle short, circular. Areolet sub-quadrate, the intercubiti parallel. Base of first tergite with a lateral tooth on either side. Ovipositor sheath 1.0-2.0 as long as hind tibia. Hind tibia without a basal whitish band.

Gambrus is a Holarctic genus with species extending into the northern parts of the Oriental Region. It is related to *Agrothereutes* and *Aritranis* and the characters of the three genera merge in some taxa. The above description will identify the genus and further details can be found in Townes (1970) treatment of the genera of *Agrothereutina*.

One species, *Gambrus amoenus*, was listed by Howard and Fiske (1911) as a parasite of the gypsy moth in Europe.

1. GAMBRUS AMOENUS (Gravenhorst) (Fig. 76)

Cryptus amoenus Gravenhorst, 1829. Ichneumonologia Europaea, 2: 623.
 (*Cryptus*) *Aritranis amoenus*: Howard and Fiske, 1911. U. S. Dept.
 Agr. Bur. Ent. Bull., 91: 85. Host: *Lymantria dispar*.

This species has been referred to as *Cryptus amoenus*, *Aritranis amoenus* or *Spilocryptus amoenus* in the literature on the gypsy moth parasites. Howard and Fiske (1911) first reported it as a parasite of *Lymantria dispar*, based upon information in their card file. Thompson (1946: 449) cites Stadler (1933) and Schedl (1936) as his source of information about its being parasitic upon the gypsy moth.

The American species *Gambrus nuncius* (Say) is a junior synonym of *Gambrus amoenus* (n. syn.), which has been reared from *Callosamia angulifera*, *Callosamia promethi*, *C. angulifera*, *Samia cynthia*, *Antheraea polyphemus*, *Acronicta* sp., and *Battus philenor*. According to Townes and Townes (1962) the normal hosts are *Callosamia* species. The parasite overwinters as a cocoon in the host cocoon and the adult emerges in the following spring. Its occurrence on the gypsy moth is doubtful or accidental.

Face closely finely punctate on a granular surface. Clypeus subconvex and shiny, with scattered punctures. Malar space mat, about equal to the basal width of clypeus. Occipital carina coming to the base of mandible and meeting the hypostomal carina near it, or a little erased at that place. Frons centrally rugoso-striate. Vertex granulose. Interocellar distance 0.85 as long as ocellocular distance. Upper part of temple mat, as wide as the width of eye in profile. Lower temple polished. Mesoscutum mat, with scattered shallow punctures. Scutellum subconvex, with scattered punctures on a smooth surface. Side of thorax rugoso-punctate, with metapleurum becoming finely reticulate. Propodeum convex, smoother basally, longitudinally striate

medially between the basal and apical transverse carinae, both of which are prominent, and rugose apicad of the apical transverse carina. First tergite smooth, second mat with scattered punctures, third finely mat and rather closely shallowly punctate and the following tergites progressively subpolished. Ovipositor about 0.66 to 0.70 the length of abdomen. Upper valve of ovipositor tip compressed, in profile view convex.

Black. Mandible medially red. Clypeus medially and scape may be red marked. Antenna brownish-black with flagellar segments 5-9 white, and segments 4 and 10 partly white. Tegula brownish-yellow in European specimen and black in American series. Legs yellowish-brown with fore coxa partly brownish and apices of hind femur and tibia blackish. Hind tibia often laterally also fuscous. Hind tarsus white. Basal three abdominal tergites orange-brown. Fourth and the following tergites black with apices of sixth and seventh tergites and often also the fifth, white.

Male: Propodeum with a faint indication of an areola. Tyloids on seven flagellar segments. Tyloids linear with the median tyloids a little widened and rounded above. Hind coxa black. Abdominal tergites 2, 3 and part of 4 orange-brown, rest black. Seventh tergite with a white triangular mark. Rest as in the female.

Length 9-11 mm. *Fore wing* 5-9 mm. *Ovipositor* 3-4 mm.

Specimens from Europe (Germany) and U.S.A. examined, but no reared specimens seen. It may be that all European specimens have been from cocoons imported from North America, and that the species is native only to North America.

Townes and Townes (1962) provided a key to the North American species. Schaffner and Griswold (1934) give biological information on this species.

2. Genus MERINGOPUS (Fig. 77)

Meringopus Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 186.

For the taxonomy of the genus, refer to Van Rossem (1969).

Medium sized insects. Clypeus strongly convex, its apical margin truncate. Malar space 0.8 to 1.2 the basal width of mandible. Mandibular teeth equal. Flagellum normal, not flattened or enlarged. Mesoscutum with smooth lateral areas, punctures sparser than on other parts. Notauli moderately deep, reaching beyond center of mesoscutum. Epomia, sternaulus and prepectal carina complete and distinct. Propodeal spiracle 2.8 to 4.0 as long as wide. Apical transverse carina of propodeum complete, forming weak lateral crests. Areolet pentagonal, large, the intercubiti convergent anteriorly. Axillary vein of hind wing strong and diverging from the anal margin. First tergite stout, without basolateral teeth. Postpetiole flat and wide, its dorsal and lateral carinae distinct. Second tergite mat, with weak sparse punctures to subpolished. Abdomen mat. Ovipositor tip short to elongate, with a nodus.

This genus is separated from other ischnine genera by the presence of clearly visible tentorial pits on the frons. *Buathra* also has conspicuous tentorial pits on the frons, but in *Buathra* the axillus vein in the hind wing is converging towards the anal margin and is usually weakly pigmented.

There are several species in Eurasia and North America. The Eurasian species were revised by Van Rossem (1969).

One species, *Meringopus cyanator* was listed by Howard and Fiske (1911)

as a parasite of the gypsy moth. No earlier reference could be traced.

2. MERINGOPUS CYANATOR (Gravenhorst) (Figs. 78, 79)

Cryptus cyanator Gravenhorst, 1829. Ichneumonologia Europaea, 2: 442.

Cryptus cyanator: Howard and Fiske, 1911. U. S. Dept. Agr. Bur. Ent. Bull., 91: 85. Host: *Lymantria dispar*.

Meringopus cyanator: Van Rossem, 1969. Tijdschr. v. Ent., 112: 188.

Trachysphyrus cyanator: Griffiths, 1976. Parasites and predators of the gypsy moth: A Review, p. 42.

Body with long brownish pilosity. Face convex medially, with a prominence below antennal sockets, closely punctate, punctures superimposed on a granular surface. Malar space granulose, 1.1 as long as the basal width of mandible. Clypeus convex, with scattered punctures on a polished surface. Frons rugose, antennal scrobes smooth, concave with tentorial pits usually well developed (sometimes weak). Vertex punctate. Temple in profile as wide as eye, punctate, the punctures sparser below, the interspaces shiny. Interocellar distance 0.87 as great as ocellocular distance. Occipital carina abruptly erased at a distance equal to the basal width of mandible and not joining hypostomal carina. Thorax strongly rugose. Mesoscutum with polished areas in between irregularly placed punctures. Epomia complete to upper margin of pronotum. Propodeum with apical transverse carina forming weak lateral crests and with an irregularly and weakly formed areola. Central area of propodeum a little convex and narrowed, followed by a longer and steep slope to the apex. Axillary vein in hind wing strongly pigmented and diverging from inner hind margin of the wing. Legs with femora and tibiae normal, not dilated or flattened respectively. Abdomen granulose. Ovipositor tip normal, teeth on lower valve not strong ventrally, nor flanged out or projecting when seen in profile.

Black. Palpi brown to black. Mandible reddish medially. Antennae brownish-black. Outer orbits with faint reddish lines. A reddish spot on vertex close to eye. Thorax black. Subtegular ridge narrowly reddish. Wings infumated. All coxae and trochanters black, femora reddish-brown, tibiae reddish brown basally and fuscous apically and dorsolaterally, tarsi largely fuscous. Abdomen blackish-brown with a faint violet iridescence. Apical margins of basal 1 or 2 tergites show faint brownish coloration.

This species is rather close to *Meringopus nigerrimus murorum* (Tschek) from Scandinavia and the Alps, but the latter species has well developed ventral ridges on the ovipositor tip.

Length: 12-8-15.7 mm. Fore wing 8.8-11.2 mm. Ovipositor 4.5-5.5 mm.

Distribution: Europe: Germany, Netherlands, Poland, Denmark, Russia.

Hosts: *Lymantria dispar*, *Panolis flammea*, *Malacosoma neustria*, *Diloba coeruleocephala*, and *Phragmatobia fuliginosa*.

3. Genus ISCHNUS (Fig. 75)

Ischnus Gravenhorst, 1829. Ichneumonologia Europaea, 1: 638.

Body usually slender. Clypeus small, convex and often pyramidal in profile, its apical margin convex. Mesoscutum mat and with minute punctures. Notaulus extending beyond center of mesoscutum. Sternaulus long and sinuate. Propodeal spiracle circular. Apical propodeal carina variable (in the species discussed here weak and broadly interrupted medially, almost indistinct). Areolet pentagonal, intercubiti convergent towards the radial vein. Axillus vein weakly pigmented and very close to the anal margin, its tip turned towards the margin. Base of first tergite with a lateral tooth on either side. First tergite slender, subpolished. Abdomen finely mat. Ovipositor about 0.5 the length of abdomen.

Ischnus assertorius Gravenhorst was apparently first listed by Rudow (1917) as a parasite of the gypsy moth. The present day name of it is *Ischnus inquisitorius inquisitorius* (Mueller). Townes and Townes (1962) recognized six subspecies of *inquisitorius*: two from Europe, one from Northern Japan, and three from North America. They have also provided a key to separate them.

3. ISCHNUS INQUISITORIUS INQUISITORIUS (Mueller) (Fig. 75)

Ichneumon inquisitorius Mueller, 1776. Zool. Danicae Prodrum, p. 151.

Ichneumon assertorius Fabricius, 1793. Entomologia Systematica, 2: 140.

Ischnus assertorius: Rudow, 1917. Ent. Ztschr. Frankfurt, 31: 67.

Hosts: *Lymantria dispar*, *Xestia triangulum*.

Face granuloso-punctate. Frons rugose. Clypeus smoother, convex. Vertex granulate, Malar space granulate, about equal to basal width of mandible. Introcular distance a little less than ocellular distance (8: 10). Temple and vertex behind lateral ocelli receding, the vertex rather abruptly so. Mesoscutum mat, with fine punctures. Thorax generally otherwise closely punctate, tending to be rugose at places. Propodeum rugulose, its apical transverse carina weak and absent in the central area, laterally forming weak crests. First tergite slender and subpolished, rest of the tergites mat. Ovipositor about half the length of abdomen, its tip finely tapered.

Black, with abdomen reddish-brown. Marks along inner orbits extending on vertical orbits, a mark between and behind lateral ocelli, a mark on the center of clypeus, anterior and upper margins of pronotum dorsally, its hind corner, subtegular ridge, scutellum apically and metascutellum, yellow. Tegula brownish-black. All coxae and trochanters, black. Legs otherwise reddish-brown, with apices of hind femur and tibia fuscous and hind tarsus a little dark-brown. Tip of abdomen black. Male darker, particularly the abdomen brown. Yellow on head more extensive. Male sometimes also has yellow marks on side of thorax and on propodeum.

Length: 8-10 mm. Fore wing 5-7 mm. Ovipositor 3-4 mm.

Distribution: Eurasia. Other subspecies occur in Japan and North America.

Hosts: *Lymantria dispar*, *Pandemis cerasana*, *Archips rosana* (Kasparyan, 1981). *Xestia triangulum* (Rudow, 1917).

According to Townes and Townes (1962) this species is related to the Japanese *Ischnus assimilis* Uchida and *Ischnus yezoensis* Uchida.

V. SUBFAMILY TRYPHONINAE

Members of the tribe Tryphoninae are small to large sized ichneumon-flies that are ectoparasitic on lepidopterous caterpillars and on sawfly larvae. They are characterized by having a medium-sized to large transverse clypeus with its apical margin usually broad and beset with a fringe of long parallel hairs. Male flagellum devoid of tyloids. Sternaulus absent or short. Propodeum usually partly to completely areolated. Sometimes (as in *Netelia*) propodeal carinae reduced or absent. Tarsal claws usually pectinate. Areolet usually present, pointed or petiolate above. Second recurrent vein usually with two bullae. Nervellus intercepted variously. First tergite with a glymma, its spiracles before the middle. Abdomen depressed or in *Netelia* compressed and slender. Ovipositor usually short, sometimes long, its tip without a subapical dorsal notch and usually without conspicuous teeth.

This subfamily contains several tribes, but only one genus (*Netelia*) of the tribe Phytodietini is associated with the gypsy moth. The tribe Phytodietini contains two genera *Phytodietus* and *Netelia*, which are external parasites of lepidopterous larvae. They are characterized by having two spurs on hind tibia, propodeum without carinae or with only sublateral crests and with transverse striations, prepectal carina present, and nervellus vertical or reclivous. The genus *Netelia* has twisted mandibles, long slender brownish colored body, and a compressed and long abdomen.

1. Genus NETELIA (Figs. 68, 133)

Paniscus of authors, not of Schrank.

Netelia Gray, 1860. Ann. Mag. Nat. Hist., (3) 5: 341.

Body long, slender, with fore wing 6 to 23 mm. long. Mandibles twisted, the lower tooth much smaller than the upper. Eye and ocelli enlarged. Eyes emarginate opposite antennal sockets. Basal $0.65 \pm$ of propodeum with transverse striations, usually with a pair of transverse crests. Nervellus intercepted above the middle. Ovipositor 1.0 to 2.0 as long as the apical depth of abdomen, its tip sharp and slender.

General body coloration brownish or ferrugineous, sometimes with a few blackish marks.

Members of the genus *Netelia* are external parasites of exposed lepidopterous larvae. Several subgenera are recognized (Townes, 1969: 149), but the two species reported from the gypsy moth belong to the subgenus *Netelia*, which has normally pectinate hind tarsal claws, occipital carina complete, nervulus distad of basal vein, lateral carina of scutellum reaching to its apex, and thorax usually without definite yellow markings.

Two species of *Netelia*—as "*Paniscus cephalotes* Holmgren" and "*P. testaceus* Gravenhorst" were reported by Rühl (1914) as parasites of *Lymantria dispar* in Europe. They have since been mentioned by Wolf and Kraube (1922), Meyer (1931) and Thompson (1946) in the gypsy moth literature. I have not come across any rearing records, nor have I seen any reared specimens of them. Both these species are only occasional parasites of the gypsy moth, if they attack it at all. These two species have often been misidentified in the past; so their true identities are uncertain.

The correct name of "*Paniscus cephalotes*" is *Netelia* (*Netelia*) *vinulae*

(Scopoli). The identity of "*Paniscus testaceus*" cannot be established and is referred here as *Netelia* sp.

1. NETELIA (NETELIA) VINULAE (Scopoli) Figs. 69-73, 133)

Ichneumon vinulae Scopoli, 1763. Entomologia carniolica. . . , p. 286.

Paniscus cephalotes Holmgren, 1858, Svenska. Vetensk Akad. Handl. (N.F.), 2 (8): 31.

Taxonomy: Rühl, 1914: 26. Townes, Momoi and Townes, 1965: 95.

Delrio, 1975: 64. Kaur and Jonathan, 1979: 137.

Female: Head wider than long. Face convex medially and moderately closely punctate. Malar space 0.2 as long as the basal width of mandible. Frons transrugulose. Temple strongly convex, as wide as eye. Occipital carina rather weak and ending shortly before the oral carina. Pronotum, mesoscutum and scutellum finely closely punctate. Mesopleurum moderately punctate and subpolished. Metapleurum and propodeum finely closely striated. Lateral crests of propodeum prominent. Hind tarsal claw strongly bent apically and with about 14 rather fine pectines and 2 ungual bristles. Tibial bristles moderate. Nervulus distad of basal vein by 0.3-0.4 its length and distinctly bent in its upper 0.4. Areolet rather small, oblique, sessile. First tergite stout and swollen, about 3.5 as long as wide at apex.

Male genitalia: Gonoforceps large and exerted, without a apico-dorsal spine. Brace broad, moderately long and supporting a large U-shaped pad apically. Penis valve normally shaped.

Color: Brown. Ocellar triangle lightly infusate. Stigma yellow.

Length: ♀: 17-19 mm. Fore wing 13.5 to 15 mm. ♂: 13-22 mm.

Distribution: Europe, China, India, Japan, Russia.

Hosts: It is apparently a polyphagous parasite of various common lepidopterous pests of forest trees, including *Lymantria dispar* and *L. monacha* (Kaun and Jonathan, 1979). As no reared specimens could be seen, its occurrence on the gypsy moth could not be confirmed.

The above description is adapted from Kaur and Jonathan (1979), who examined the lectotype of *N. cephalotes*. The type of *N. vinulae* no longer exists.

2. NETELIA (NETELIA) sp.

Paniscus testaceus Gravenhorst: Rühl, 1914. Soc. Ent., 29 (5): 26.

Host: *Lymantria dispar*. Europe.

Rühl (1914) reported *Paniscus testaceus* Gravenhorst as a parasite of *Lymantria dispar*, which record has been repeated in literature. However, no reared specimens are at hand to confirm the identity of the species involved. Nor have any subsequent rearing records been discovered in the literature.

The identity of *N. testaceus* is very doubtful and the type is also lost. This species has often been misidentified in the past. Delrio (1974) who revised the western Palaearctic species of *Netelia*, listed it as "*species incerte sedis*", mentioning that it is a composite species. Meyer (1936) apparently confused it with *Netelia melanurus* (Thomson) when he reported *melanurus* as a parasite of the gypsy moth in 1936, but not in his taxonomic

treatment of *melanurus* in 1935.

Netelia melanurus is a rather distinct species with a black abdominal tip. Since what Rühl referred to as *testaceus* is uncertain, the record from the gypsy moth is referred here as *Netelia (Netelia)* sp.

Townes, Momoi and Townes (1965) and Delrio (1974) provide further information on Palaearctic *Netelia* species and their hosts.

VI. SUBFAMILY BANCHINAE

The subfamily Banchinae includes moderately long, stout or slender insects with fore wing 1.8 to 16 mm. long. Clypeus small, wide or narrow, usually separated from face by an epistomal groove, its apical margin round, notched or truncate, without an apical fringe of hairs. Mandibular teeth equal to subequal, the upper sometimes broad to obliquely truncate. Male flagellum without tyloids. Sternaulus absent or short. Postpectal carina absent. Propodeum with apical transverse carina evenly arched and usually strong. Tarsal claws usually pectinate. Areolet present or absent. Nervellus intercepted variously. First abdominal segment stout to slender, its spiracles before the middle, or at middle, its dorsolateral carinae usually absent. First sternite not fused with its tergite. Glymma nearly always present. Abdomen depressed, its apex often compressed. Female subgenital plate large, prominent, its apex with a median notch. Ovipositor with a subapical notch, without a node, the lower valve without teeth. Ovipositor and its sheaths long to short.

Members of the subfamily Banchinae are usually internal parasites of lepidopterous larvae. Oviposition is usually within the young larvae. Emergence of the adult parasite is from a cocoon spun after the parasite larva has killed and left its host.

Only one genus *Banchus* has been associated with the gypsy moth. Keys to separate it from other genera and tribes of Banchinae are given by Townes (1970).

1. Genus BANCHUS Fabricius (Figs. 80, 137, 138)

Banchus Fabricius, 1798. Supplementum Entomologiae Systematicae, p. 209, 233.

For synonymical references refer to Townes (1970). Townes and Townes (1978) treated the Nearctic species. Chandra and Gupta (1977) treated the Oriental species. Aubert (1978) gives a catalog and host records of the Palaearctic species.

Body moderately stout. Face broad above, weakly narrowed toward lower side. Apical margin of clypeus with a median notch. Upper tooth of mandible wider and longer than the lower tooth and its apex with a weak concavity. Malar space 0.5 to 0.8 the basal width of mandible. Eye emarginate near antennal socket. Fourth segment of maxillary palpus nearly always expanded apically, the expansion faint to strong and more expanded in the male. Occipital carina entire or interrupted medially above, joining hypostomal carina above base of mandible. Prepectal carina absent. Apex of scutellum usually with a median point or spine. Propodeum short, its apical transverse carina complete or erased medially. Propodeal spiracle long, elliptic. Areolet

usually large, receiving second recurrent vein near the middle. Nervulus distad of basal vein by 0.2 to 0.6 its length. Nervellus intercepted far above the middle. Abdomen apically compressed. First tergite without dorsal or dorsolateral carinae. Epipleura of tergites 2 and 3 about 0.7 as wide as long. Ovipositor very short, its sheaths about 0.13 as long as hind tibia.

Two species of *Banchus* are reported in literature as parasites of the gypsy moth, viz., *Banchus femoralis* Thomson = *hastator* (Fabricius) and *B. falcator* Fabricius = *falcatorius* (Fabricius). The record of the latter species was apparently based upon guess work. None of these species have turned up in subsequent rearings and no voucher specimens are available to confirm their association with the gypsy moth.

KEY TO THE SPECIES OF BANCHUS ASSOCIATED WITH THE GYPSY MOTH

Apex of scutellum with a median spine. Abdominal tergites black, sub-polished. Inner orbits yellow (broadly so in male). Hind femur blackish. Europe. 1. *hastator* (Fabricius)

Apex of scutellum with a median point, without a conspicuous spine. Abdominal tergite 2 with a broad reddish-brown band (sometimes apex of tergite and base of tergite 3 also reddish-brown). In males tergites 1-3 largely yellowish-brown. Inner orbits in female black and in male largely yellow. Hind femur yellowish-brown or yellow in male. Europe. Doubtful, almost certainly erroneous record.

2. *falcatorius* (Fabricius)

1. BANCHUS HASTATOR (Fabricius) (Fig. 137)

Ichneumon hastator Fabricius, 1793. Entomologia Systematica, 2: 167.

Europe.

Banchus femoralis Thomson, 1897. Opuscula Entomologica, 22: 2411.

Sweden. Syn. by Fitton, 1978.

Banchus femoralis: Kolubajiv, 1934. Acta Ent. Soc. Ent. Csl., 31: 114.

Czechoslovakia. Host: *Lymantria dispar*.

Kolubajiv (1934) apparently reared it from the gypsy moth for the first time in Czechoslovakia. No subsequent rearing record has been seen.

Female: Face punctate. Clypeus, inner orbits, frons and vertex, mat with frons a little rough and dull. Frons excavated and with circular striations just above antennal sockets. Malar space 0.7 to 0.8 as long as the basal width of mandible. Interocellar distance 1.2 as long as the ocellocular distance. Tip of flagellum tapered, narrowed and cylindrical. Mesoscutum, mesopleurum and metapleurum punctate, punctures on mesoscutum closer than those on mesopleurum and metapleurum. Scutellum shiny, with minute scattered punctures, its apex with a pointed spine, about 0.25 as long as the length of scutellum. Scutellum with erect hairs surrounding the spine. Propodeum leathery, ruguloso-punctate in basal half and rugose to a little rugose striate in apical half. Its apical transverse carina weak and irregularly represented. Propodeal spiracle long, linear. Abdomen polished, with shallow scattered and minute punctures on basal three tergites. First tergite flat dorsally, without dorsal carinae, a little depressed apicad of the projecting spiracles. Ovipositor short, its sheaths hardly exerted, more or less parallel-sided,

wider and truncate apically.

Black. Face broadly along inner orbits and narrowly along outer orbits, clypeus, scape ventrally, tegula, fore femur on the anterior aspect, fore tibia largely, middle femur dorsally, and middle tibia except apically, and all second trochanters, yellow. Tegula often and apex of scutellum surrounding the spine, brownish to brownish-yellow. Fore and middle femora with black marks. Fore and middle tibiae and tarsi brownish at places. Hind leg largely black or blackish-brown, with apex of femur, basal 0.6 of tibia and base of basitarsus, yellowish-brown. All coxae and first trochanters black. Metapleurum often with a yellow oval spot. Abdomen with brownish or yellowish brown apical margins on tergites 1-3. Basal 2-3 sternites often apically broadly yellow.

Male: Similar to the female in sculpture and coloration, except for the following sexual differences:

Tip of flagellum somewhat attenuate and flattened. Flag setae on flagellar segments not visible (may be present, but small). Fourth segment of maxillary palpus flattened and widened apically. Face largely yellow with only a broad central black stripe. Scutellar spine short. Oval yellow spot on metapleurum absent. Abdominal tergites black. Male claspers with a concave lower margin, tapered apically (appear beak-like).

Length: 11-13 mm. Fore wing 8.5 to 10 mm. Ovipositor 0.5 mm.

Specimens: Several males and females from Europe examined in Townes Collection. No reared specimen seen.

Distribution: Europe.

Hosts: *Lymantria dispar*, *Panolis flammea*, *Zeiphera diniana* (= *griseana* Hb.) and *Diprion* sp. (after Thompson, 1957).

2. BANCHUS FALCATORIUS (Fabricius)

Ichneumon falcatorius Fabricius, 1775. Systema Entomologiae, p. 332. Denmark.

Banchus falcatorius: Fabricius, 1798. Suppl. Ent. Syst., p. 234.

Banchus falcator Fabricius: Morley, 1915. Revision of Ichneumonidae in British Museum, 4: 138. Germany. Syn., hosts. [Doubtful association with the gypsy moth.].

This species was first reported as a parasite of *Lymantria dispar* by Morley (1915), which has been cited by Aubert (1978). Morley's record was based on a male specimen from Germany, bearing the following data, "Between Wilmannsdorf and Schwangendorf, 6 PM, under willows, also flying. Larva of *L. dispar* (gypsy moth) common." It is clear that the host association was simply by guess-work.

Since there is no definite evidence of the association of *B. falcatorius* with the gypsy moth, and since it has not been reared from that host subsequently, this species is to be removed from the list of ichneumonid parasites associated with the gypsy moth.

VII. SUBFAMILY CREMASTINAE

Members of the subfamily Cremastinae are long slender insects with fore wings 2.5 to 14 mm. long. Abdomen strongly compressed. Eyes bare. Ocelli of male sometimes enlarged. Clypeus small to large, separated from face by an epistomal groove, its apical margin convex. Mandible short, bidentate. Sternaulus absent. Prepectal carina present. Postpectal carina complete. Propodeum usually completely areolated, with longitudinal as well as transverse carinae. Spurs of all tibiae set in a membranous area that is separated from the membranous area of tarsal insertion by a sclerotized bridge (not seen in other ichneumonids). Tarsal claws partly to completely pectinate. Epipleurum of third tergite not separated or only partly separated from its tergite. Female subgenital plate unspecialized, usually not visible. Ovipositor long, with a subapical dorsal notch.

Members of the subfamily Cremastinae are internal parasites of lepidopterous larvae living in concealed situations. Some of them also attack coleopterous larvae, or larvae in exposed situations, like the gypsy moth. Emergence of the parasite is from the mature larva about to pupate.

Only one genus and species, *Pristomerus vulnerator* (Panzer) has been associated with the gypsy moth in Eurasia and North Africa.

1. Genus PRISTOMERUS Curtis (Fig. 81)

Pristomerus Curtis, 1836. British Entomology, 13: 624.

For full synonymical references and relationships with other cremastine genera, refer to Townes (1971). This genus is easily distinguished from all other genera treated in this paper by having a tooth on the lower side of hind femur and ovipositor tip sinuate.

Body moderately slender. Abdomen moderately to strongly compressed apically. Occipital carina usually complete. Lateral carina of scutellum absent, or present only basally. Hind femur often swollen and with a ventral tooth followed by a series of minute teeth, especially in male. Stigma wide. Radial cell short. Areolet absent. Nervellus intercepted near its lower 0.35. First tergite moderately slender, usually longitudinally carinate. Lower edges of first sternite nearly parallel-sided, not touching each other. Thyridium on second tergite transverse or subcircular, near base of the tergite. Epipleurum of second tergite narrow, separated by a crease, and turned under. Apex of male clasper rounded. Ovipositor long, only a little shorter than fore wing, its tip sinuate.

1. PRISTOMERUS VULNERATOR (Panzer) (Fig. 81)

Ichneumon vulnerator Panzer, 1799. Faune Insectorum Germanicae, Heft 72, pl. 5. Europe.

Pristomerus vulnerator: Curtis, 1836. British Entomology, 3: 624. England.

Pristomerus vulnerator: Barsacq, 1913. Rev. Phytopath. Appl. Paris, 1(5): 70-73. France. Host: *Lymantria dispar*.

Pristomerus vulnerator: Mokrzecki, 1913. Reports [of the Chief Entomologist to the Zemstov] on Injurious Insects and Diseases of Plants in Govt. of Taurida during the year 1912. Simferopol, 1913, p. 1-23. Host: *Lymantria dispar*.

For fuller synonymical references, hosts and distributional records, refer to Townes, Momoi and Townes (1965).

Barsacq (1913) and Mokrzecki (1913) first reported it parasitic in young caterpillars of gypsy moth in France and Taurida (Russia) respectively. Meyer (1927) reported having reared it in Russia. Obrtel (1949) and Sedivy (1970) gave an extensive host range for this species.

Female: Face punctate, granuloso-punctate along inner orbits. Clypeus smooth. Width of face almost equal to the length of face and clypeus. Malar space about 0.7 the basal width of mandible, punctate. Temple and vertex posteriorly strongly receding from the eye. Temple 0.25 the width of eye. Vertex concave above. Occipital carina close to the lateral ocelli, distant from the ocelli by about the ocellar diameter or slightly more than that. Vertex and frons (excluding the antennal scrobes), closely finely granulose. Interocellar distance equal to the ocellocular distance. Mesoscutum granuloso-punctate, punctures set on a granular surface. Scutellum flat, punctate, subpolished in between punctures. Mesopleurum punctate, interspaces equal to at least the diameter of the punctures and shiny. Metapleurum somewhat coarsely punctate. Pleural area punctate, with interspaces equal to the diameter of the punctures and shiny. Propodeal spiracles situated at or a little below the middle of the spiracular carina (pleural part of basal transverse carina). Propodeum convex, shallowly to moderately punctate. Areola smoother and petiolar area usually transrugose. Propodeal areolation complete. Areola broad, 1.5 times as long as its maximum width at costula. Costula arising at basal 0.33 to 0.4 of the length of areola. Apical closing carina of areola often weak in the middle. Hind coxa strongly granulose. Hind femur with one strong tooth in apical 0.33, followed by a series of minute teeth between it and apex. First and second tergites longitudinally striate. The following tergites subpolished and compressed. Ovipositor long, its sheath 0.66 as long as the fore wing, its tip sinuate.

Male: Eyes strongly diverging ventrally. Vertex constricted. Ocelli large and raised. Ocellocular space almost obliterated. Propodeal carinae strong. Areola a little longer and narrowed apically and basally, widest at costula. Costula arising from basal 0.6 of areola. Pleural area of propodeum and metapleurum somewhat sparsely punctate and subpolished, sometimes a little strongly and irregularly so. Otherwise similar to the female.

Black. Head devoid of brownish orbital marks. Mandible, tegula, and fore and middle legs except their coxae, yellow. Scape and pedicel black to brownish-black. Coxae black. Fore coxa may be partly brown. Hind leg brownish-yellow with black marks on trochanter, femur, and apex of tibia and tarsus except basally. The extent of black on hind leg variable. Abdomen black either wholly or apices of tergites brownish-yellow, or apical tergites largely yellowish-brown.

In males third tergite usually partly to wholly yellowish-brown. Sometimes faint brownish lines seen along inner orbits.

Length: 6-7 mm. Fore wing 4 to 4.5 mm. Ovipositor 4 mm.

Distribution: Eurasia, China, Japan, Korea.

Hosts: *Lymantria dispar* and many other common lepidopterous pests [see Meyer (1927), Obrtel (1949) and Šedivý (1970)].

Pristomerus vulnerator appears to be a variable species occurring in Eurasia. It is closely related to *Pristomerus orbitalis* Holmgren and the two have often been mixed up in European literature. *P. orbitalis* has a wider face, wider than high, wider temples, ocellocular distance greater than inter-ocellar distance, vertex not strongly concave behind, occipital carina considerably away from lateral ocelli, in males lateral ocelli distinctly separated from eye margin, mesoscutum punctate, without granulations, propodeum smoother, propodeal areola narrow and elongate, about 4.0 as long as wide, and propodeal spiracle usually above the middle on the spiracular carina. The hind coxa is minutely punctate, not densely granulose as in *P. vulnerator*. The head is with yellowish-brown orbital stripes encircling the eyes.

VIII. SUBFAMILY ANOMALINAE

The subfamily Anomalinae is characterized by having a coarsely reticulate propodeum, and a long, slender and strongly compressed abdomen. Clypeus often not separated from face by a groove, its apex often with a median point. Occipital carina often at the outer margin of head. Head quadrate. Mandible bidentate. Epomia usually long. Sternaulus absent. Propodeum reticulate wrinkled, without carinae, its apex often produced beyond bases of coxae. Areolet absent. Legs long, slender. First tergite slender, long, without a glymma, its tergite and sternite fused, and spiracle behind the middle. Abdomen strongly compressed. Ovipositor and its sheaths short. Ovipositor with a subapical dorsal notch.

Members of the subfamily Anomalinae are internal parasites of the larvae of Lepidoptera, except that the genus *Anomalon* is reported from Coleoptera. The emergence is from the pupa. The parasite larva spins a flimsy cocoon within the pupae of Lepidoptera. The larval morphology is similar to that of the Metopiinae.

Rudow (1911) reported two species of "*Anomalon*" from *Lymantria dispar* as well as *L. monacha*, viz., *Anomalon flaveolatum* Gravenhorst and *A. pallidum* Gravenhorst. The former species now belongs to *Agrypon* while the latter to *Barylypa*. Why no subsequent cataloger has listed these species as gypsy moth parasites, is unknown to me. Kirchner (1856) reported *Anomalon* (*Trichomma*) *enecator* Rossi as a parasite of *Lymantria dispar*. Morley (1915) stated that Gaulle (1908) bred it from *Lymantria dispar* in France. Kovacevic (1925) reported *Barylypa perspicillator* Gravenhorst as a parasite of the gypsy moth in Yugoslavia. This name is a junior synonym of *B. delictor* (Thunberg). None of these parasites have been confirmed as gypsy moth parasites by subsequent rearings, nor have I seen any reared specimens of them.

KEY TO THE GENERA OF ANOMALINAE ASSOCIATED WITH THE GYPSY MOTH

1. Eye surface hairy. Inner margins of eyes strongly convergent toward mandible. Ovipositor sheath 2.0 to 3.8 as long as the apical depth of abdomen. Discoidella and often also the brachiella veins absent.
 1. *Trichomma* (*Trichomella*)
- Eye surface bare. Inner margins of eyes weakly convergent, or parallel. Ovipositor sheath less than 2.0 the apical depth of abdomen. 2

2. Discoidella present. Frons with a median vertical carina. Postnervulus intercepted near upper 0.25. 2. Barylypa
 Discoidella absent. Frons without a median vertical carina. Postnervulus intercepted near upper 0.38. 3. Agrypon

1. Genus TRICHOMMA (Fig. 84)

Trichomma Wesmael, 1849. Bull. Acad. Roy. Sci. Lett. Beaux-Arts Belgique, 16(2): 119, 139.

Trichomella Szépligeti, 1910. Notes Leyden Mus., 32: 91.

Inner eye margins moderately to very strongly convergent ventrad. Eyes with long dense hairs. Frons without a median carina or tooth, often with transverse wrinkles. Apex of clypeus convex or subtriangular, with a median tooth that varies from very small to large. Temple narrow. Occipital carina complete, close to ocelli and reaching base of mandible, separate from hypostomal carina. Lower tooth of mandible a little shorter than the upper. Flagellum moderately long, lower front corner of pronotum truncate. Epomia present. Scutellum flat to convex, carinate laterally. Prepectal carina extending to 0.5 the height of mesopleurum. Sternaulus absent. Posterior mesosternal carina interrupted in front of each middle coxa. Propodeum and metapleurum reticulate. Apex of propodeum extending up to 0.5 the length of hind coxa. Tarsal claws pectinate on basal half or more. Middle tibia with two spurs. Nervulus a little distad of basal vein. Intercubitus basad of second recurrent vein. Discoidella and brachiella veins present or absent. Postnervulus meeting discocubital cell before its middle. Second tergite much longer than the third. Epipleurum of third tergite not separated by a crease. Ovipositor 2.0 to 3.8 as long as the apical depth of abdomen.

Species of *Trichomma* are generally parasites of the larvae of Microlepidoptera, particularly those which are concealed in rolled leaves, mining in soft plant tissues, etc. Oviposition is into the host larva and the adult emerges from the host pupa by biting off the entire anterior end of the puparium. *Trichomma enecator* (Rossi) was, however, reported as a parasite of *Lymantria dispar* by Kirchner (1856).

1. TRICHOMMA (TRICHOMELLA) ENECATOR (Rossi) (Fig. 85, 86)

Ichneumon Enecator Rossi, 1790. Fauna Etrusca, 2: 48. Italy.

Anomalon (Trichomma) enecator: Kirchner, 1856. Lotos, 6: 150.

Czechoslovakia. Host: *Lymantria dispar*.

Trichomma (Trichomella) enecator: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 362.

This species was first reported as a parasite of *Lymantria dispar* (= *Bombax dispar*) by Kirchner (1856) from Czechoslovakia. According to Morley (1915) it is a parasite of a number of tortricid hosts in England, but was also bred from the pupae of *Lymantria dispar* by de Gaulle in France. It is listed as a parasite of *Lymantria dispar* in Europe by several subsequent cataloguers, like Wolf and Kraube (1922), Meyer (1931), Stadler (1933), Schedl (1936), and Thompson (1946), etc.

Female: Face a little convex, minutely punctate as well as polished.

Clypeus polished, pointed apically. Frons rugoso-striate. Malar space 0.2 the basal width of mandible. Interocellar distance 1.1 the ocellocular distance. Mesoscutum rugoso-punctate. Scutellum shallowly rugose, flat dorsally and strongly carinate laterally. Upper 0.3 of pronotum polished and a little swollen medially with widely spaced parallel and strong carinae. Mesopleurum transcarinate, carinae somewhat weaker centrally and interspaces punctate. Metapleurum and propodeum reticulate, with honey-comb like cells. Hind wing with distal abscissa of cubitella, discoidella and brachiella virtually absent. Petiole slender, circular in cross-section. Postpetiole a little swollen. Tergite 2, 1.75 as long as the third. Third and the following tergites strongly compressed laterally and their epipleurae not separated from the tergites by a crease. Ovipositor long, slender, about 3.2 to 3.5 as long as the apical depth of abdomen, and 0.75 as long as the fore wing.

Black. Face, clypeus, mandible, palpi, outer orbital border narrowly, upper margin of pronotum (narrowly to broadly), scutellum centrally, often fore and middle legs largely, and hind trochanters yellow. Postpetiole, hind femur, basal half of hind tibia and whole of tarsi, and ventrolateral aspects of abdominal tergites, yellowish-brown. Hind coxa, trochanter, base of femur, and apical 0.3 to 0.6 of tibia often brown (extent of brown variable). Base of hind tibia often brown.

Length 10-11 mm. *Fore wing* 5.5 to 6.0 mm. *Ovipositor* 4.0-4.5 mm.

Specimens: Several females seen in the Townes Collections from Europe, but no specimens reared from the gypsy moth are at hand.

Hosts: *Lymantria dispar*. Several other hosts are listed by Gauld and Mitchell (1977) and Kasparyan (1981), but not the gypsy moth.

Distribution: Eurasia. Japan.

2. Genus BARYLYPA Foerster (Fig. 87)

Barylypa Foerster, 1869. Verh. Naturh. Ver. Rheinlande, 25: 156.

Inner eye margins weakly convergent ventrad. Eye surface hairless. Frons with a median vertical carina. Apex of clypeus pointed medially. Occipital carina complete, close to posterior ocelli, joining hypostomal carina at or immediately before mandibular base. Lower mandibular tooth about 0.6 as long on the upper. Antenna moderately long, that of female without a white band. Clypeus usually with a median apical tooth. Scutellum short, weakly convex and usually with lateral carina. Lower anterior margin of pronotum without a tooth, lower corner truncate. Epomia running along pronotal collar, not deflected above. Middle tibia with two spurs. Tarsal claws pectinate up to middle. Intercubitus basad of second recurrent vein. Postnervulus intercepted near upper 0.25. Discoidella present. Tergite 2 much longer than tergite 3, its epipleura separated by a crease. Abdomen apically strongly compressed, with epipleura of tergite 3 onwards not separated by a crease. Ovipositor about 2.0 or long as apical depth of abdomen.

Two species of *Barylypa* are reported in literature as parasites of the gypsy moth, viz., *B. delictor* (Thunberg) and *B. pallida* (Gravenhorst).

1. BARYLYPA DELICTOR (Thunberg) (Fig. 88, 89)

Ichneumon delictor Thunberg, 1822. Mém. Acad. Imp. Sci. St. Pétersbourg, 8: 265; 1824, Ibid, 9: 319. Sweden.

Barylypa delictor: Roman, 1912. Zool. Bidr. Från Uppsala, 1: 249.

Barylypa perspicillator Gravenhorst: Kovacevic, 1925. Sumar List., 49(1): 1-5. Yugoslavia. Host: *Lymantria dispar*.

Barylypa perspicillator (Gravenhorst) was first reported from the gypsy moth by Kovacevic (1925). Meyer (1935) synonymized *perspicillator* under *delictor* (Thunberg).

This species is unknown to me. No specimens could be examined. Kasparyan (1981) gives a key to the Eurasian species.

Distribution: Eurasia.

Hosts: Several hosts are mentioned by Meyer (1931-36), Šedivý (1957) and Kasparyan (1981), including *Lymantria dispar*.

2. BARYLYPA PALLIDA (Gravenhorst)

Anomalon pallidum Gravenhorst, 1829. Ichneumonologia Europaea, 3: 675. Rudow, 1911. Internat. Ent. Ztschr., 5: 99. Host: *Lymantria dispar*.

Barylypa pallida: Schmiedeknecht, 1908. Opuscula Ichneumonologica, 19: 1507.

This species was first reported from the gypsy moth by Rudow (1911) but has not been listed subsequently by Schedl or Thompson. Kasparyan (1981) provides a key to distinguish it from other Eurasian species. He also lists *B. humeralis* Brauns as a synonym of it. It is unknown to me.

3. Genus AGRYPON Foerster (Fig. 90)

Agrypon Foerster, 1860. Verh. Naturh. Ver. Rheinlande, 17: 151.

This genus is rather similar to *Barylypa* and the main differences appear to be the absence of discoidella vein in the hind wing, frons without a vertical carina, and the epomia with a different course. The postnervulus is intercepted near upper 0.38, and not very high as in *Barylypa*. Other characters are mostly similar (cf. Townes, 1971, pp 144 and 139). Townes also provides fuller synonymical references.

4. AGRYPON FLAVEOLATUM (Gravenhorst) (Fig. 90)

Ophion flaveolatum Gravenhorst, 1807. Vergl. Uebers. Zool. Syst., p. 268.

Anomalon flaveolatum: Rudow, 1911. Internat. Ent. Ztschr., 5: 99. Europe. Hosts: *Lymantria dispar*, *L. monacha*.

Agrypon flaveolatum: Townes, Momoi and Townes, 1965. Mem. Amer. Ent. Inst., 5: 373.

This has not been reported subsequently from the gypsy moth. It occurs in Europe, China, Japan and Korea. Kasparyan (1981) gives some diagnostic characters and a long list of hosts, but not the gypsy moth. Schmiedeknecht (1908) gave a description of it.

IX. SUBFAMILY OPHIONINAE

Members of the subfamily Ophioninae are characterized by having a slender, long, and compressed abdomen with the first tergite long, tubular and its spiracles placed far behind the middle. Ocelli very large. Clypeus separated from the face by a groove. Tarsal claws pectinate. Epomia absent. Second brachial cell with a long spurious vein, that parallels its hind margin. Areolet absent, the intercubitus far distad of the second recurrent vein. Ovipositor short and with a subapical dorsal notch, without any ridges on the lower valve.

They are medium to large sized species with longer wings. The body color is usually pale brown. Adults are generally crepuscular or nocturnal.

Members of the subfamily Ophioninae are world wide in distribution. They are endoparasites of medium to large sized lepidopterous larvae.

Only two genera, *Ophion* and *Enicospilus* have been associated with the gypsy moth, by one species of each genus. Rearing records are scanty. There are no recent records and no reared material was available for study. Even the identities of the species of the genera *Ophion* and *Enicospilus* are subject to doubt (Gauld, 1976, 1978) and Gauld and Mitchell (1978, 1981).

KEY TO THE GENERA OF OPHIONINAE ASSOCIATED WITH THE GYPSY MOTH

1. Posterior transverse carina of mesosternum broadly interrupted in front of each middle coxa. Mandibles normal, teeth in the same plane and equal. Fore wing without a glabrous area (fenestra). . . . 1. Ophion
- Posterior transverse carina of mesosternum complete or rarely incomplete. Mandibles strongly narrowed and twisted apically, teeth subequal. Fore wing with a fenestra, often with one or more sclerites present. 2. Enicospilus

1. Genus OPHION (Fig. 82)

Ophion Fabricius, 1798. Suppl. Ent. Syst., p. 210, 235.

Townes (1971) provides synonymical references and a key to the world genera of Ophioninae. Gauld (1976, 1978) gives information on the British and some European species.

Body long and slender. Color reddish-brown, sometimes with pale stripes on mesoscutum. Fore wing 8 to 21 mm. long. Ocelli large, the lateral ones almost touching the eye. Antenna long, slender, longer than the length of the fore wing. Mandible not narrowed, nor twisted apically, teeth equal or nearly equal. Notauli generally sharply impressed in anterior 0.3 to 0.4. Scutellum moderately convex, usually without lateral or with short lateral carinae. Posterior transverse carina of mesosternum present only as lateral rudiments.

Propodeum partly to completely areolated, or rarely without carinae. Fore wing with pterostigma rather stout. Areolet absent. Discocubital cell without a fenestra, but with a small hairless area below the base of stigma. Fore tibial spur with a membranous flange behind the macrotrichial comb.

Only one species, *Ophion luteus* (Linnaeus) is mentioned in literature as a parasite of the gypsy moth.

1. "OPHION LUTEUS (Linnaeus)"

Ichneumon luteus Linnaeus, 1758. Systema Naturae, (Ed. 10), 1: 566.

Ophion luteus: Townes, Momoi and Townes, 1965. Mem. Amer. Ent.

Inst., 5: 317. Synonymical references and distribution. Holarctic.

Kolomiyetz (1958) reported having reared this species from gypsy moth pupae in Siberia in July 1954. It was considered as a rare parasite. This is apparently the first record of an *Ophion* species from *Lymantria dispar*. It has, however, been previously reported several times as a parasite of *Lymantria monacha*.

Gauld (1976, 1978) mentioned that *Ophion luteus* (Linnaeus) has been a commonly misidentified species. According to him *Ophion luteus* of authors is *Ophion slaviceki* (Kriechbaumer). He (1978) provided a key to distinguish the two and the others occurring in Britain.

Which one of the above mentioned two species was actually reared by Kolomiyetz cannot be ascertained without the specimens. The following table will distinguish the two:

<i>Ophion luteus</i>	<i>Ophion slaviceki</i>
Outer tibial spur of middle leg less than 0.8 as long as the fourth tarsal segment. Smaller species, fore wing 13-15 mm. long.	Outer tibial spur of middle leg 0.8 or more as long as the fourth tarsal segment. Larger species, fore wing 15-18 mm. long.

Characters in common of these two species are: Propodeum with transverse carinae. Malar space less than 0.5 the basal width of mandible. First subdiscoidal cell unevenly hairy. Ocelli a little away from the eye. Antenna with less than 64 segments. Middle tibial spurs unequal in length.

Brown. Interocellar area and propodeum entirely orange-brown to yellowish. Wings slightly yellow-tinged. Thorax uniformly brown, never pale marked except rarely on mesepimeron.

Distribution: Europe.

2. Genus ENICOSPILUS (Figs. 83, 139)

Enicospilus Stephens, 1835. Illustrations of British Entomology, Mandibulata, 7: 126.

Some of the recent studies on the genus are of Townes (1971), and Gauld and Mitchell (1978, 1981).

Body slender. Abdomen long and strongly compressed. Antenna long. Eyes and ocelli large. Malar space short. Mandible wide at base and strongly

narrowed and somewhat twisted before the middle, its upper tooth longer than the lower. Notauli indistinct. Scutellum usually long, its lateral carina reaching to apex or to near apex. Posterior mesosternal carina usually complete. Propodeum with basal carina present or rarely obsolete, without other carinae except that oblique or longitudinal wrinkles may be present apically. Pterostigma rather narrow. Areolet absent. Discocubital cell with a small to large glabrous area (fenestra), usually containing 1, 2 or several corneous scleromes. Fore tibial spur without a membranous flange, with only an antennal brush of closely spaced hairs.

General body color pale brown to reddish-brown with abdominal tip often black marked.

Only one species, *Enicospilus merdarius* (Gravenhorst) has been mentioned in literature as parasitic on the gypsy moth. The earliest record could be traced back only to Rühl (1914). There is no recent rearing record confirming its association with the gypsy moth.

Gauld and Mitchell (1981) mention *Enicospilus transversus* Chiu as a parasite of *Lymantria* sp. from Bangalore, India.

2. ENICOSPILUS MERDARIUS (Gravenhorst) (Fig. 83)

Ophion merdarius Gravenhorst, 1829. Ichneumonologia Europaea, 3: 698.

Enicospilus merdarius: Stephens, 1835. Illustrations of British Entomology, Mandibulata, 7: 311.

This species occurs in Europe. It has often been misidentified in literature and does not occur in the Orient (Gauld and Mitchell, 1981). In the absence of reared specimens it is difficult to ascertain if it is really a parasite of the gypsy moth.

Face finely punctate. Clypeus convex, smoother, its apical margin almost smooth and impressed. Upper tooth of mandible about 2.0 as long as the lower. Frons, vertex and temple smoother, subpolished. Interocellar distance about 2.0 the ocellocular distance. Occipital carina complete. Mesoscutum very minutely punctate and subpolished. Scutellum elongate, slightly convex and minutely punctate, its lateral carina strong and reaching apex of scutellum. Mesopleurum finely punctate, its central area often striato-punctate. Prepectal carina arched toward anterior margin of mesopleurum but not touching it. Metapleurum punctate to rugoso-punctate. Propodeum smooth basad of basal transverse carina, circularly reticulo-striate in the depressed area covering petiolar region. Disco-cubital cell with two scleromes in the fenestra, the distal sclerome not distinct, the proximal sclerome pear-shaped, and the central sclerite rounded-oval but its inner side toward quadra irregular and unpigmented. Wings moderately densely hairy. Abdomen strongly compressed, with first tergite tubular. Second and the following tergites with dense short hairs. Thyridium elongate, separated from base of second tergite by about 2.5 to 3.0 its length. Ovipositor short, not longer than the apical depth of abdomen, pointed apically.

Reddish-brown, with orbits, face, frons and clypeus, largely yellowish. Tip of abdomen not black. Sometimes apical segments ventrally a little darker.

Length: 20-24 mm. Fore wing 14-16 mm. Ovipositor 3 mm.

Specimens from various localities in Europe examined in the Townes Collection. No reared material was available.

Hosts: *Lymantria dispar* (vide Rühl, 1914). Kasparyan (1981) lists only

Panolis flammea as its host. Wolff and Krausse (1922), and Meyer (1935) mentioned it from the gypsy moth in Germany and Russia respectively. Stadler, Schedl and Thompson also listed it as such.

This species is very similar to, if not the same as the North American *Enicospilus purgatus* (Say).

X. SUBFAMILY XORIDINAE

Members of the subfamily Xoridinae are parasitic upon wood boring Coleoptera and therefore all records from *Lymantria* are erroneous.

Rudow (1911) listed two species from the gypsy moth, viz., *Xylonomus irrigator* Fabr., and *Xorides praecatorius* Fabr. Both belong to *Xorides*. They are not parasitic upon the gypsy moth. They are therefore removed from the list of gypsy moth parasites.

Another species, *Odontomerus dentipes* Gmelin was recorded by Morley (1908: 11) from *Lymantria monacha*. Morley's record was from an erroneous reporting of Ratzeburg (1844).

XI. SUBFAMILY SCOLOBATINAE

1. OPHELTES GLAUOPTERUS (Linnaeus)

Members of this genus are parasitic upon *Cimbex* (saw flies) and not on Lepidoptera. The record of its occurrence on *Lymantria dispar*, originating from Rühl (1914) is erroneous. This species is therefore to be removed from the list of parasites of the gypsy moth.

Györfi (1963) mentioned having reared it from the gypsy moth in Hungary. Evidently there was some mix up either in the hosts reared, or in the determinations.

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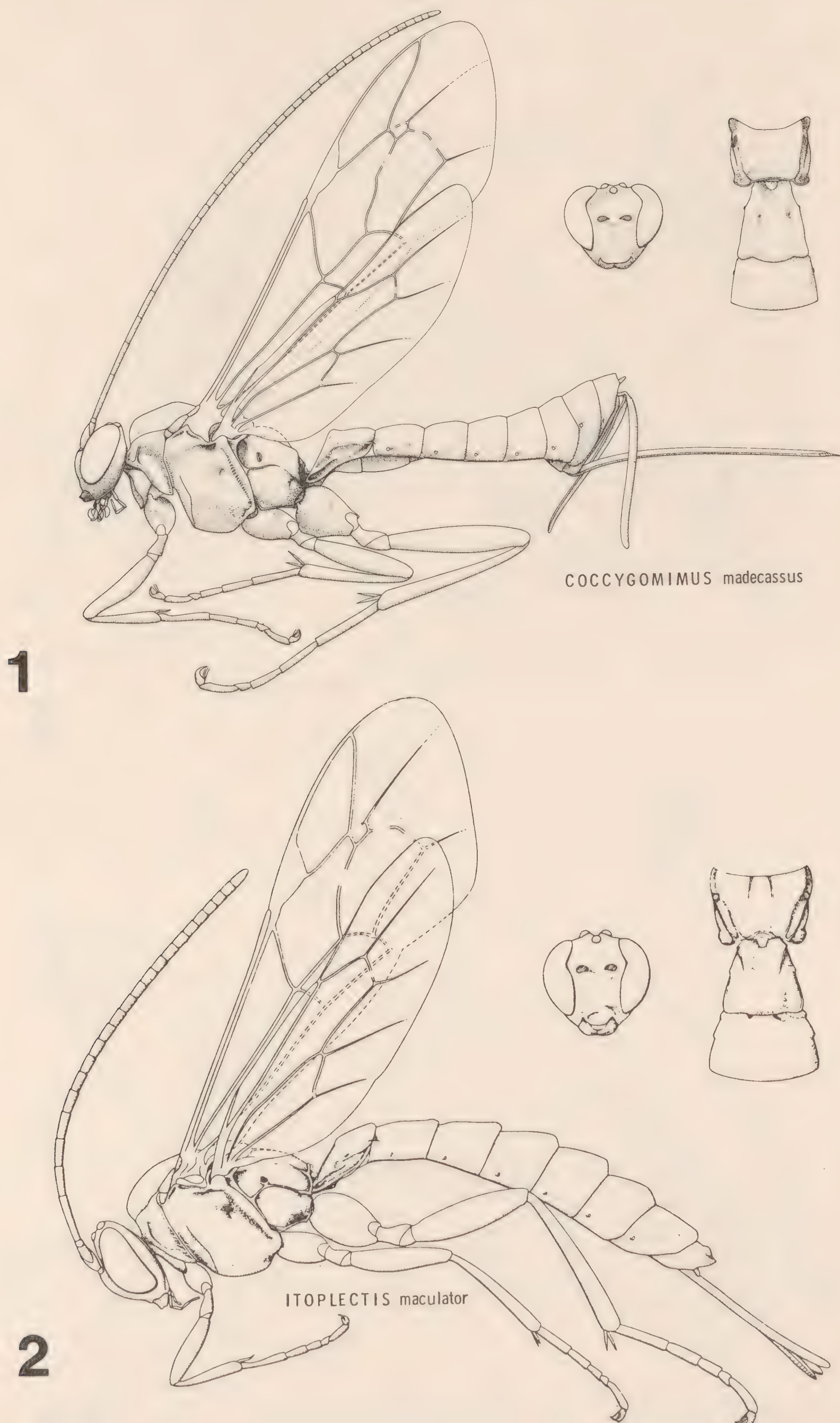
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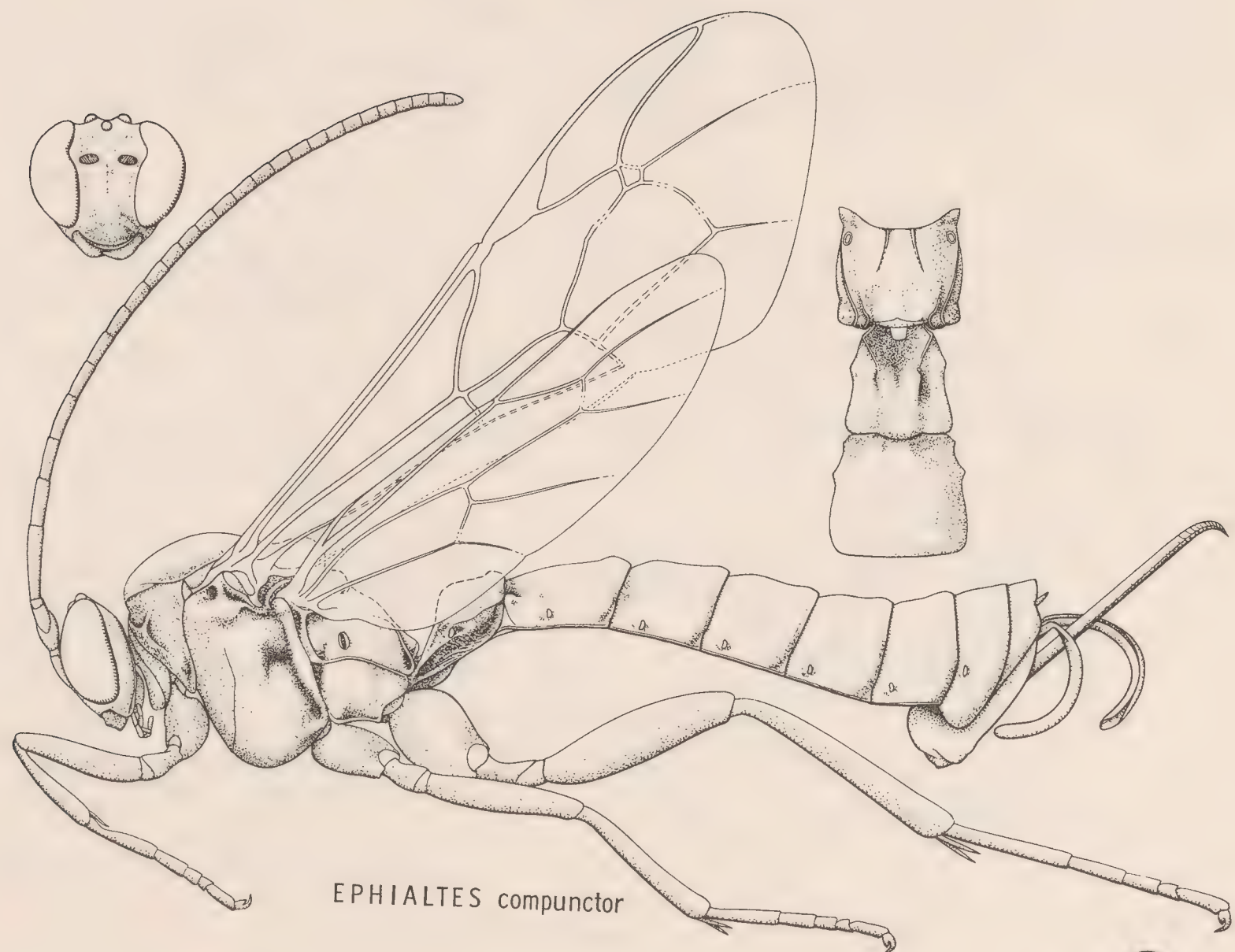
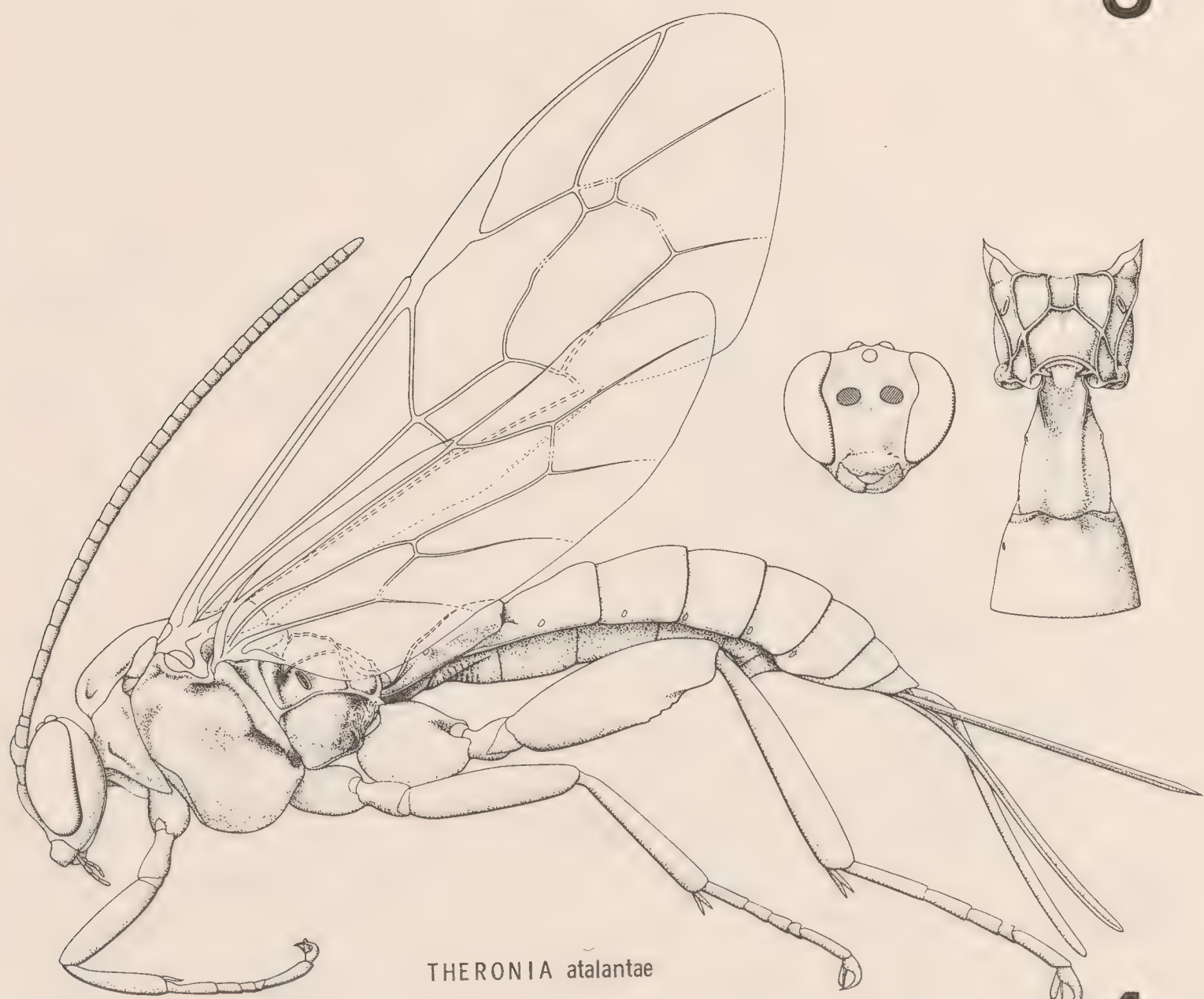
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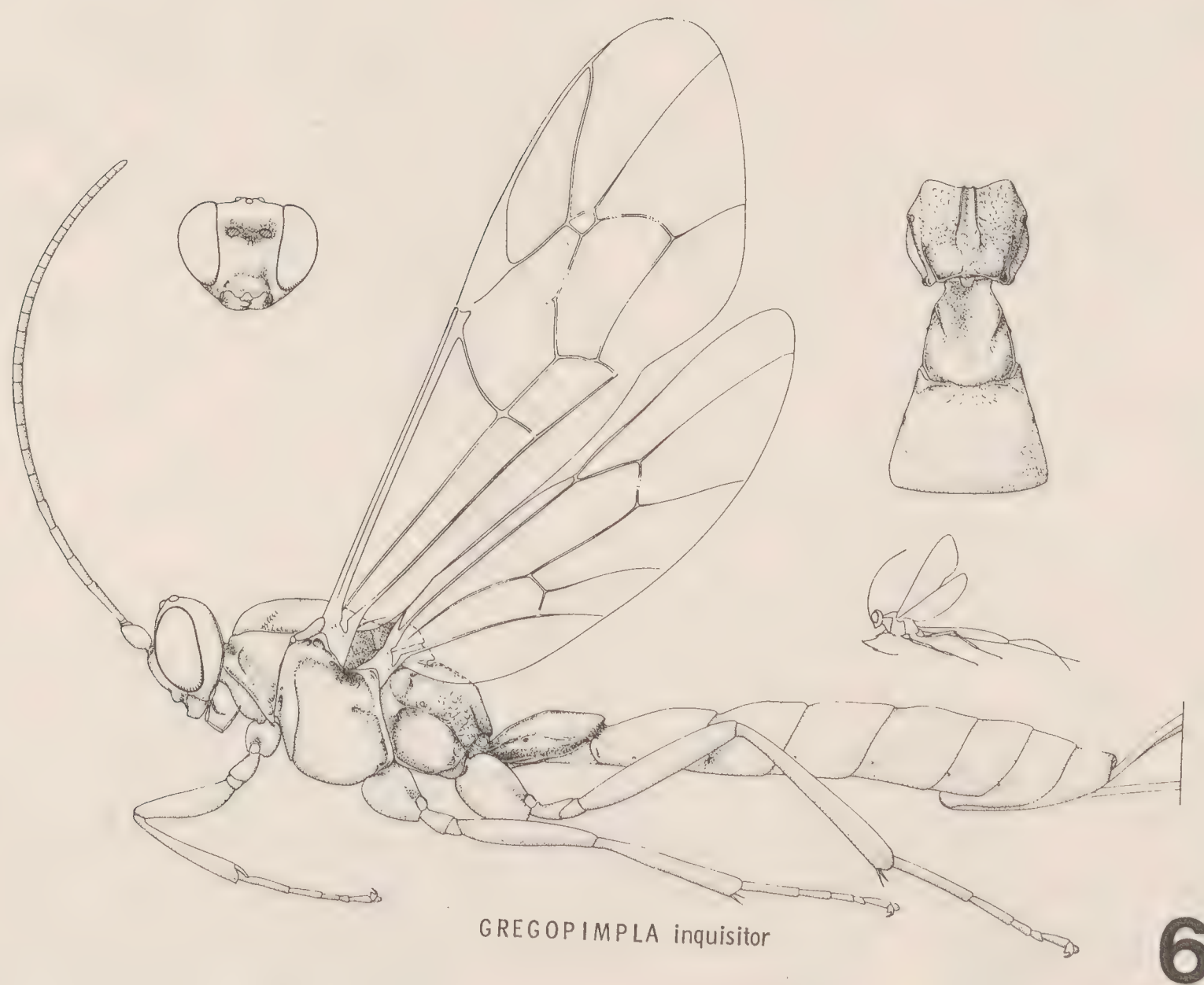
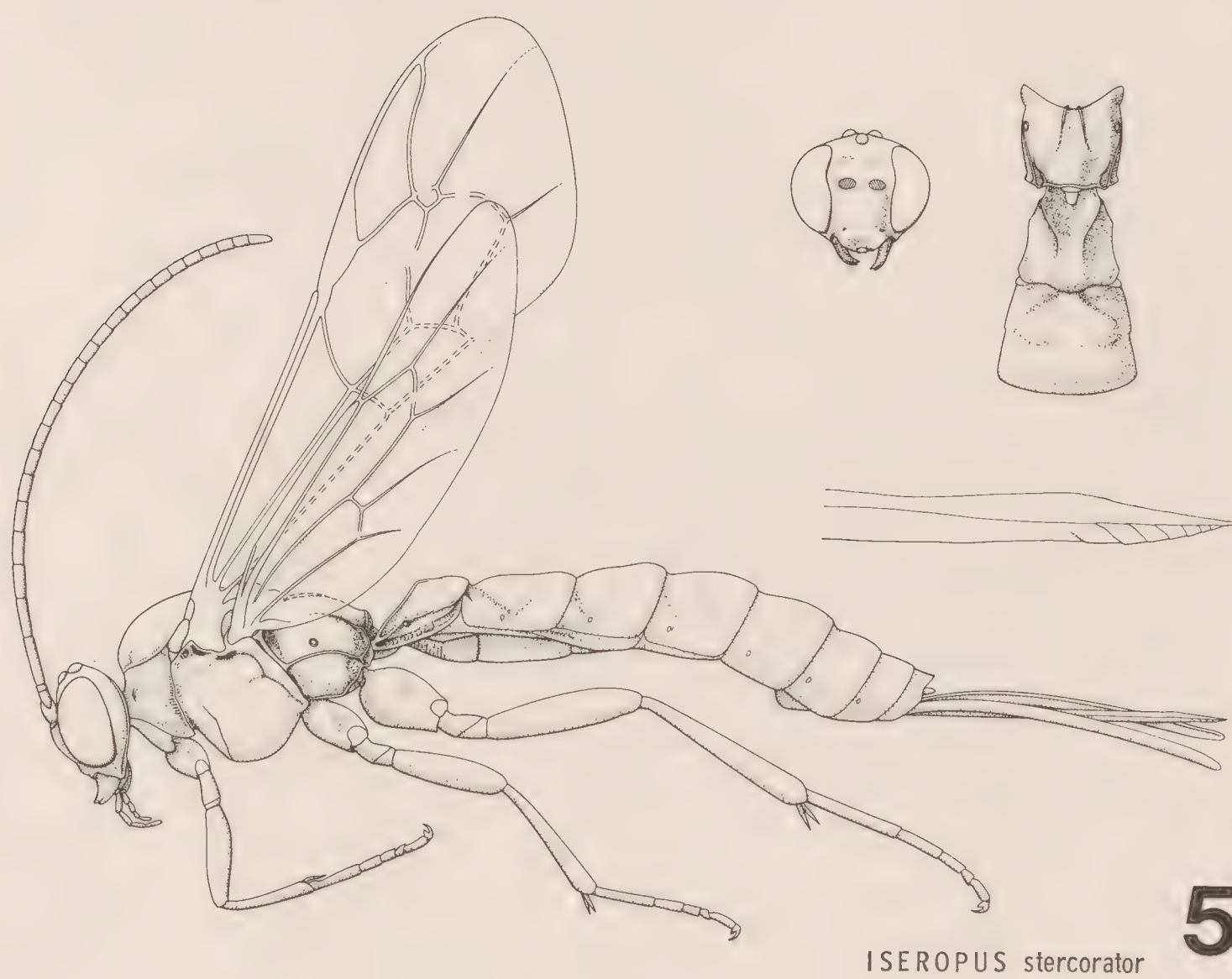
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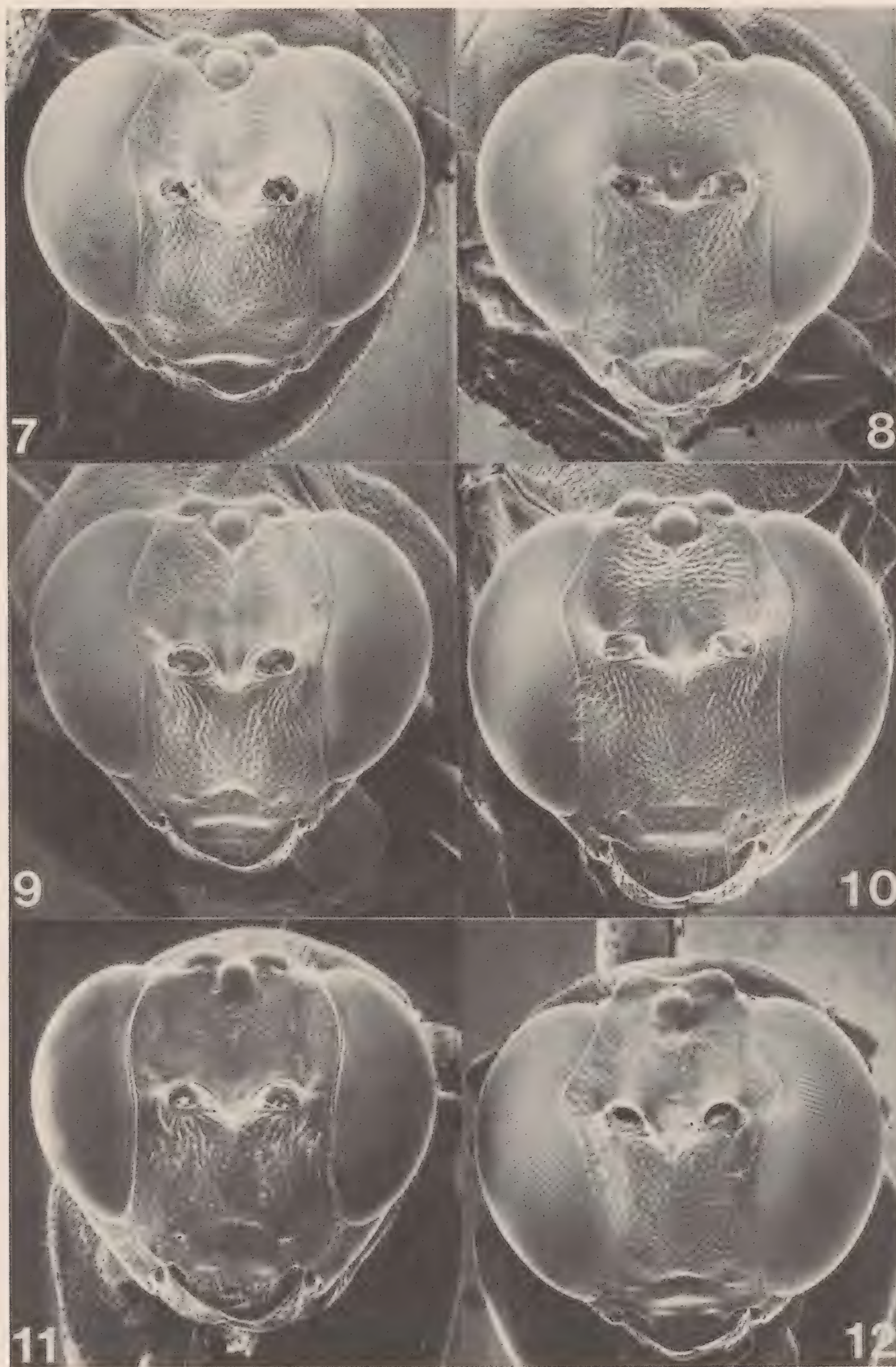
Figs. 1-2. Generic diagrams of: 1, Coccygomimus.
2, Itoplectis.

**3****4**

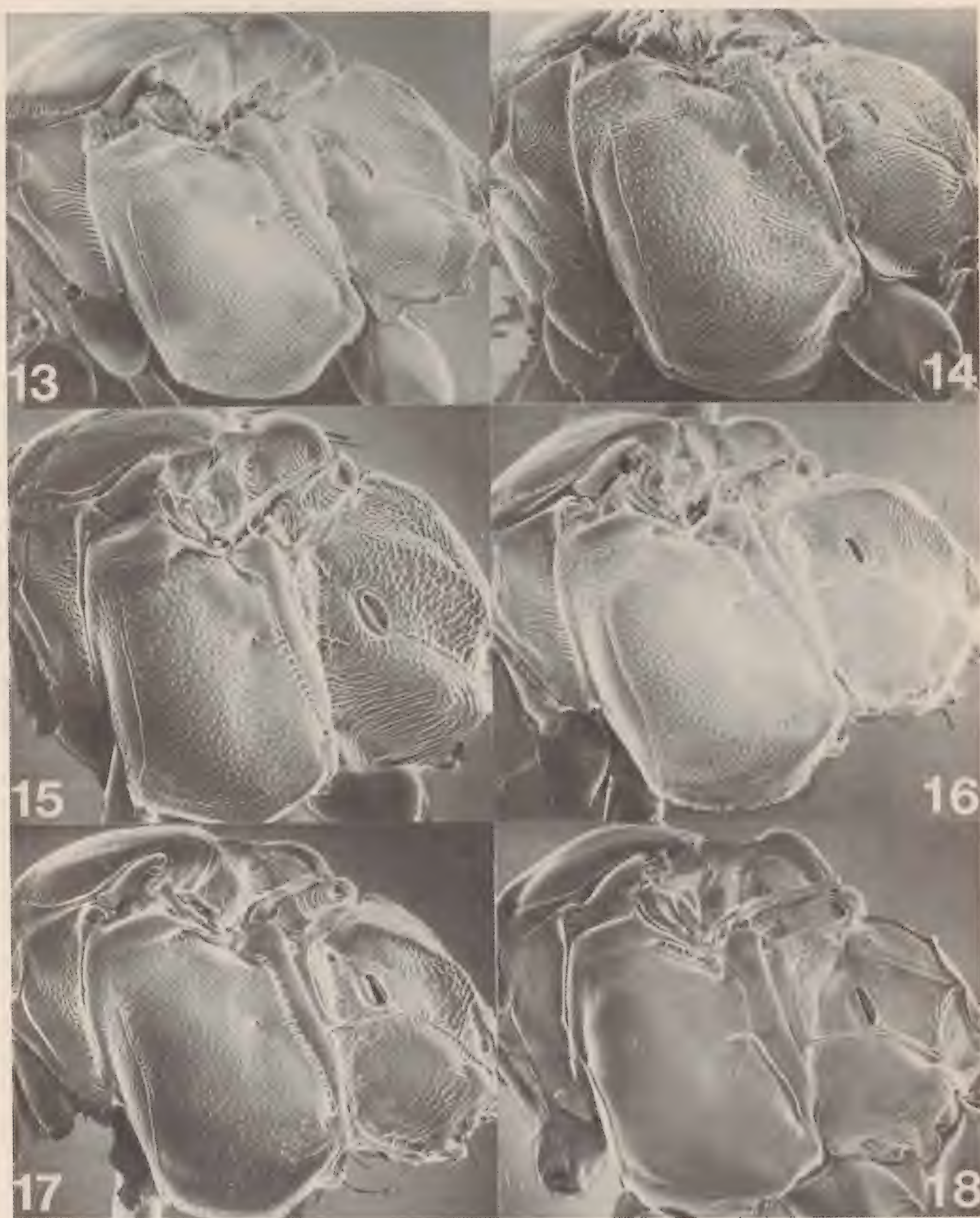
Figs. 3-4. Generic diagrams of: 3, Ephialtes.
4, Theronia.



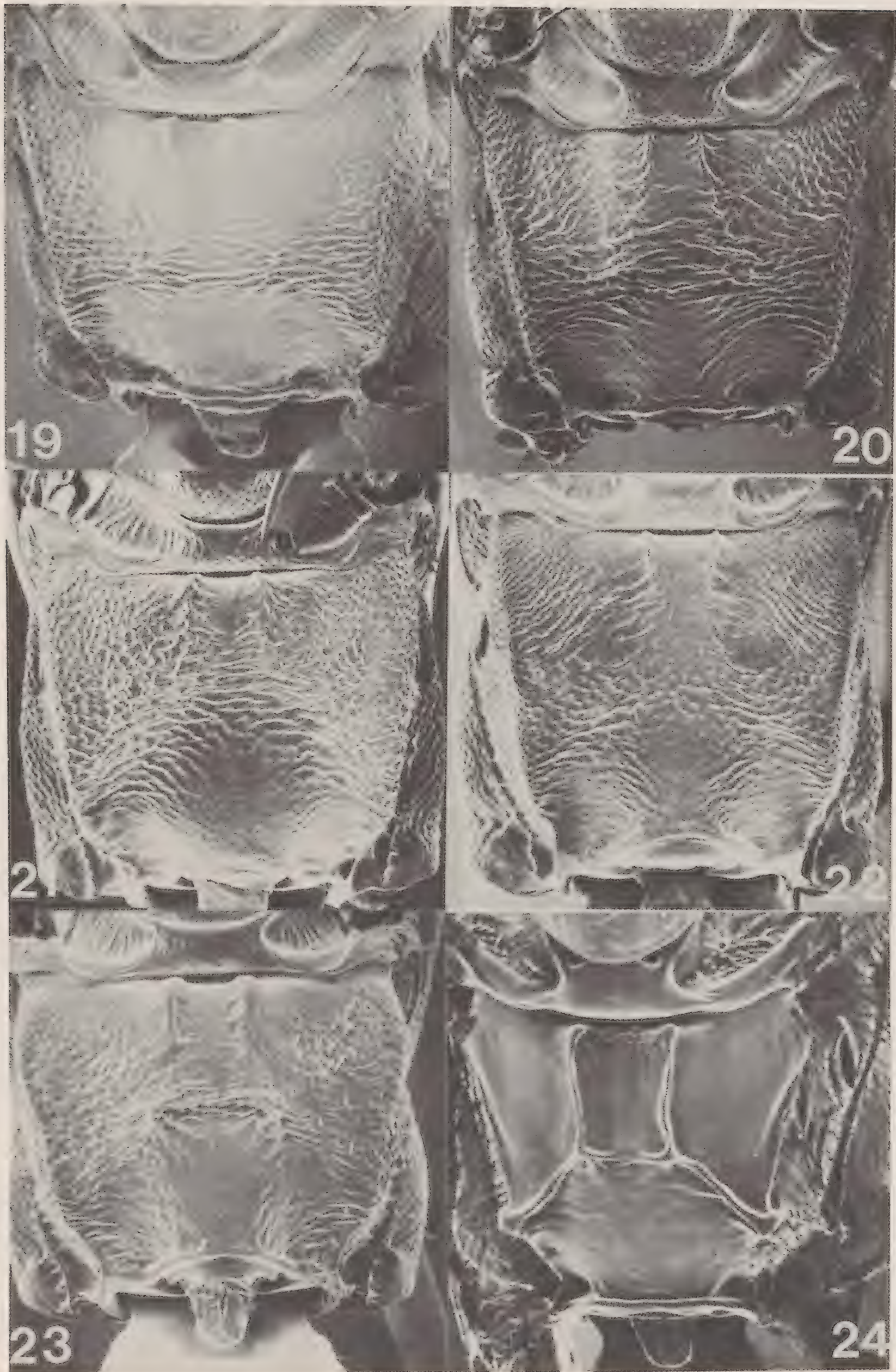
Figs. 5-6. Generic diagrams of: 5, Iseropus.
6, Gregopimpla.



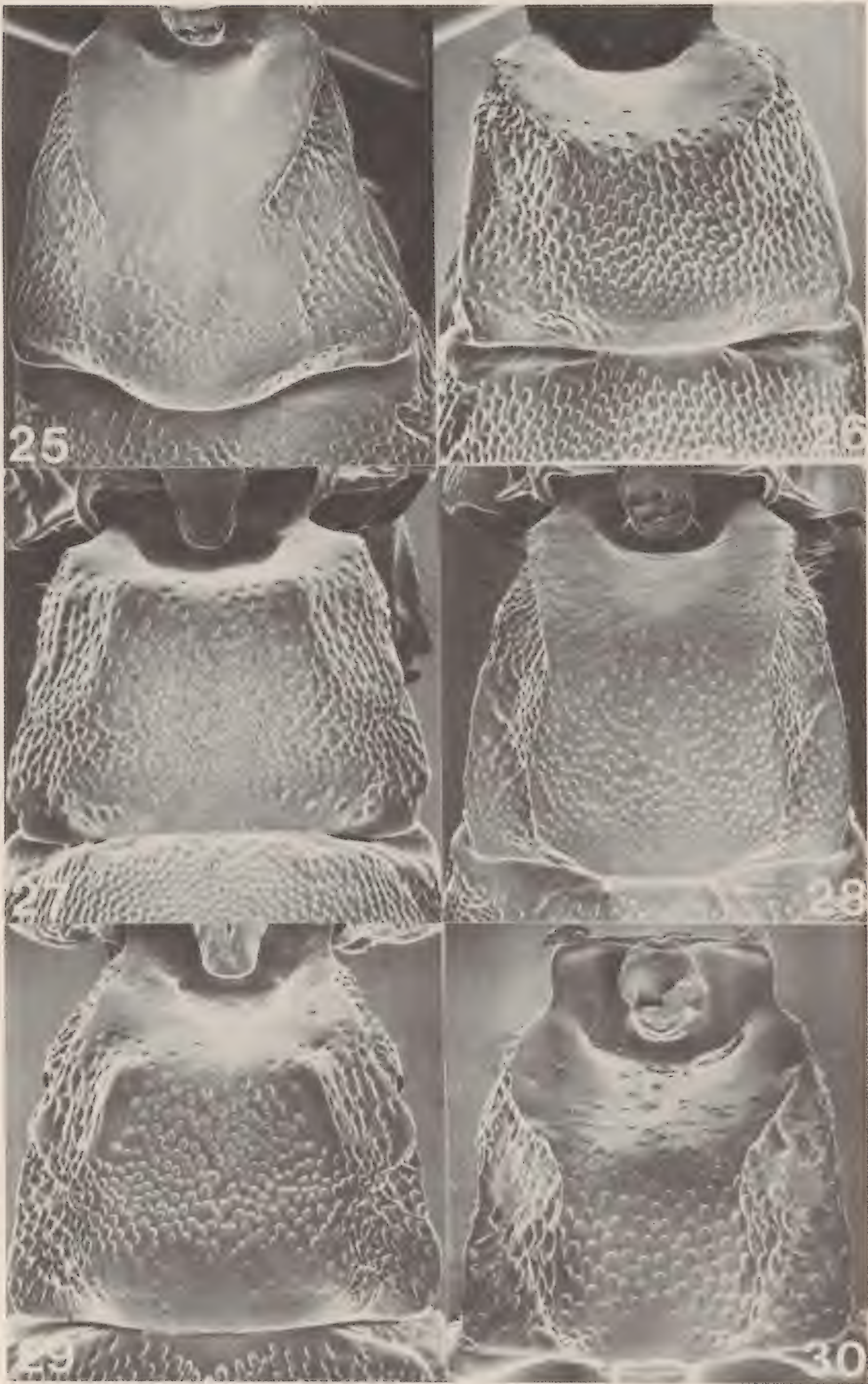
Figs. 7-12. Head, front view of: 7, Coccygomimus turionellae. 8, C. moraguesi. 9, C. instigator. 10, C. disparis. 11, C. pedalis. 12, Itoplectis alternans.



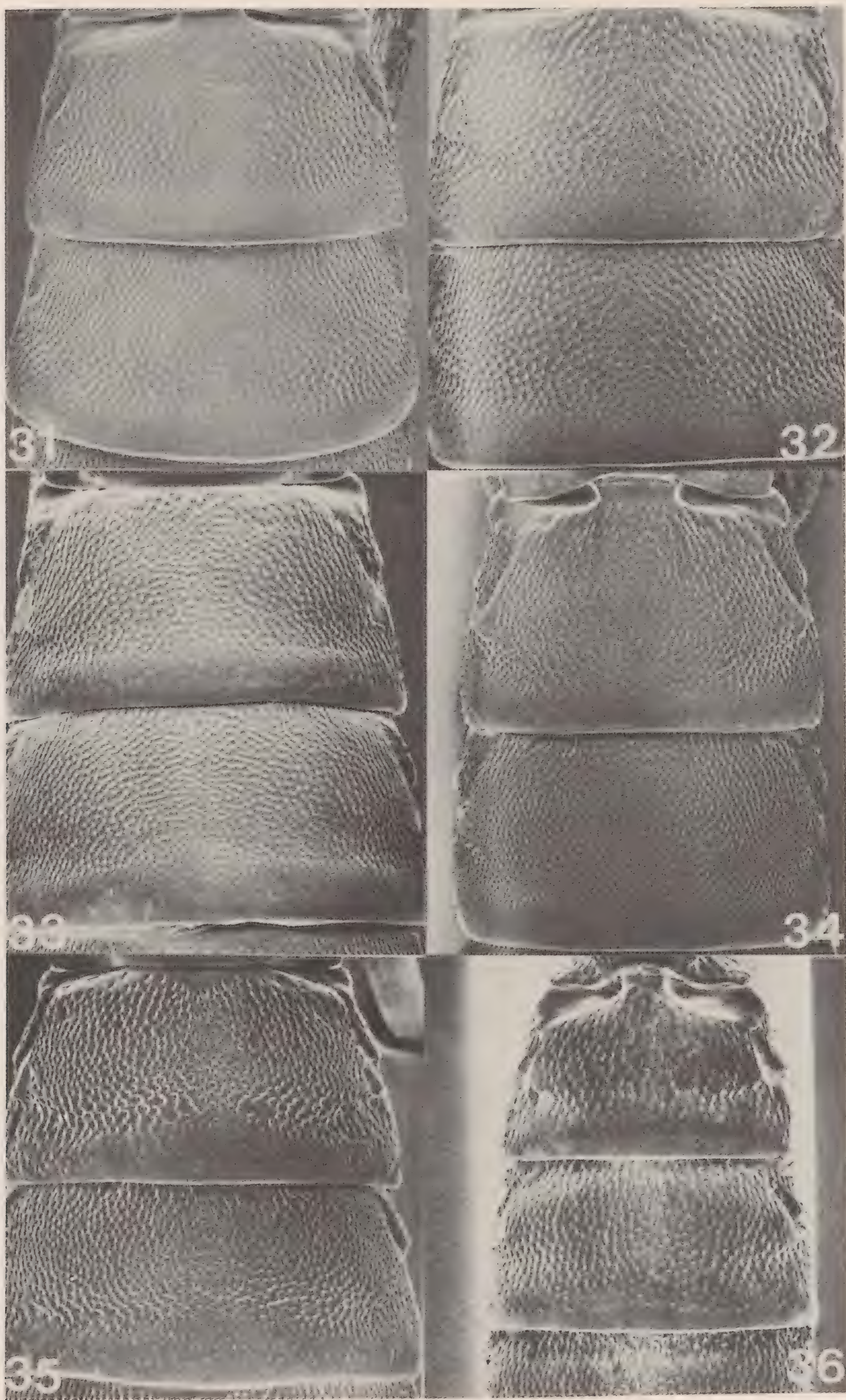
Figs. 13-18. Thorax, side view of: 13, Coccygomimus turionellae. 14, C. moraguesi. 15, C. instigator. 16, C. disparis. 17, C. pedalis. 18, Theronia atalantae fulvescens.



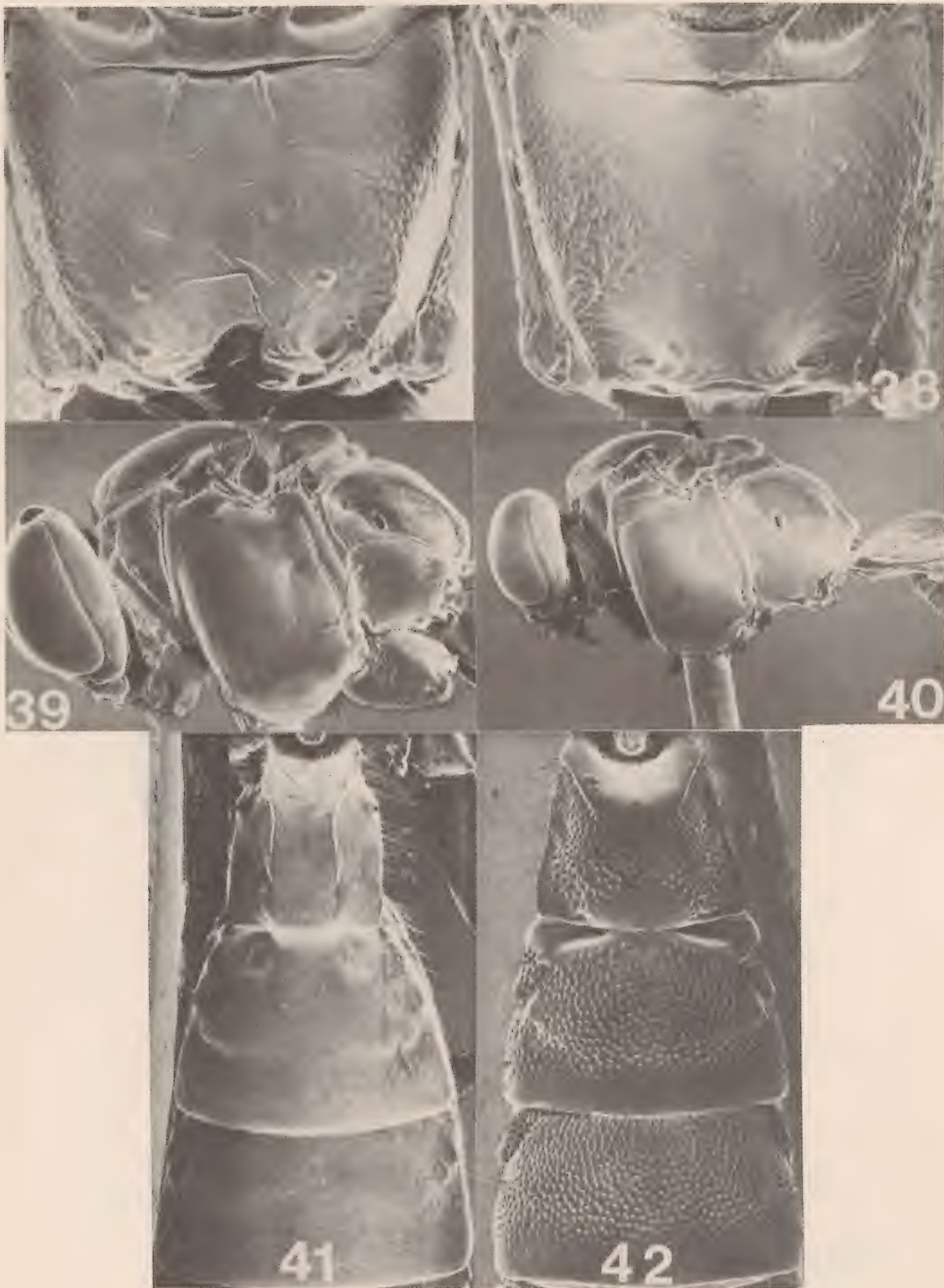
Figs. 19-24. Propodeum of: 19, Coccygomimus turionellae. 20, C. moraguesi. 21, C. instigator. 22, C. disparis. 23, C. pedalis. 24, Theronia atalantae.



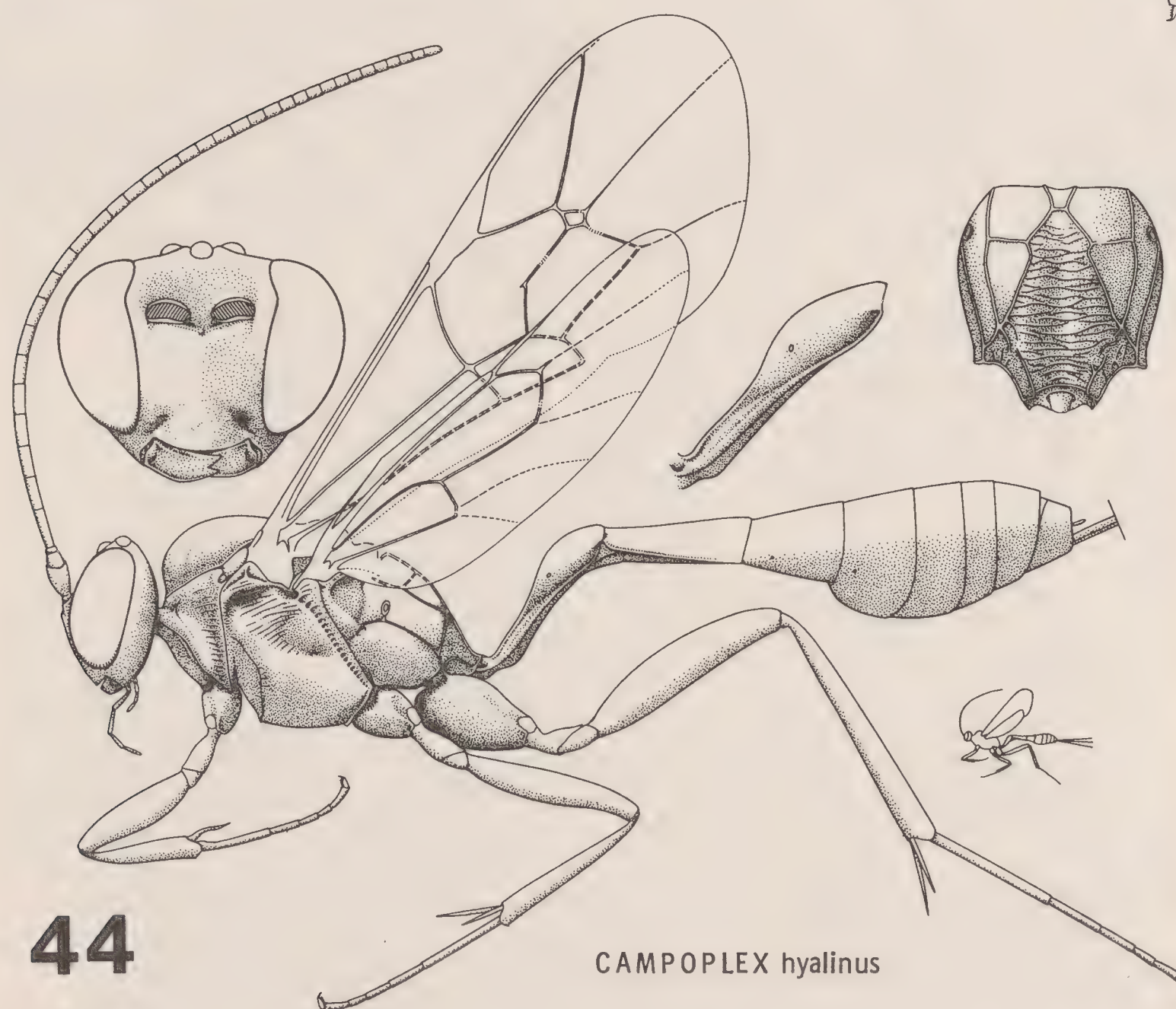
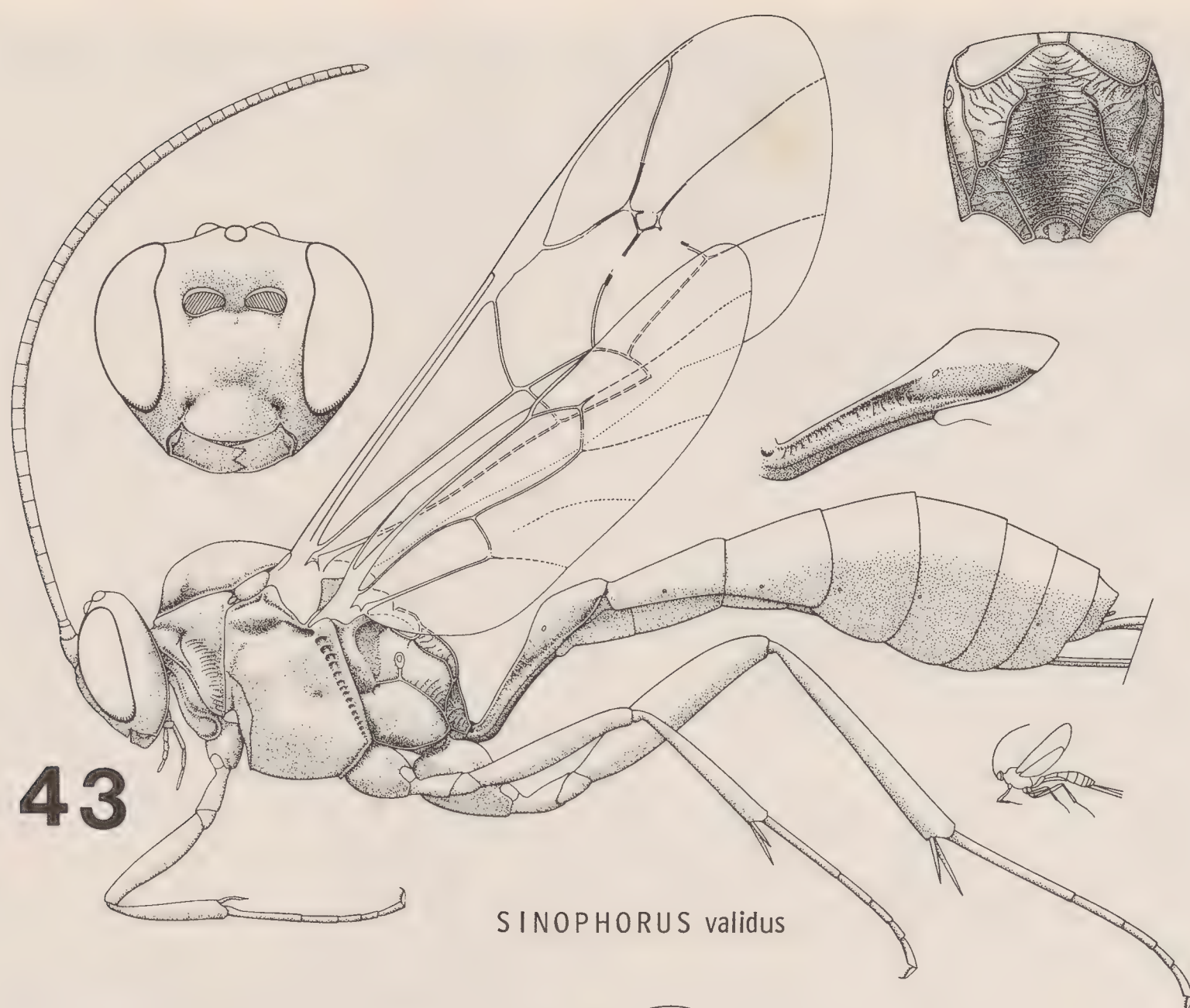
Figs. 25-30. First abdominal tergite of: 25, *Coccygomimus turionellae*. 26, *C. moraguesi*. 27, *C. instigator*. 28, *C. disparis*. 29, *C. pedalis*. 30, *Itoplectis alternans*.



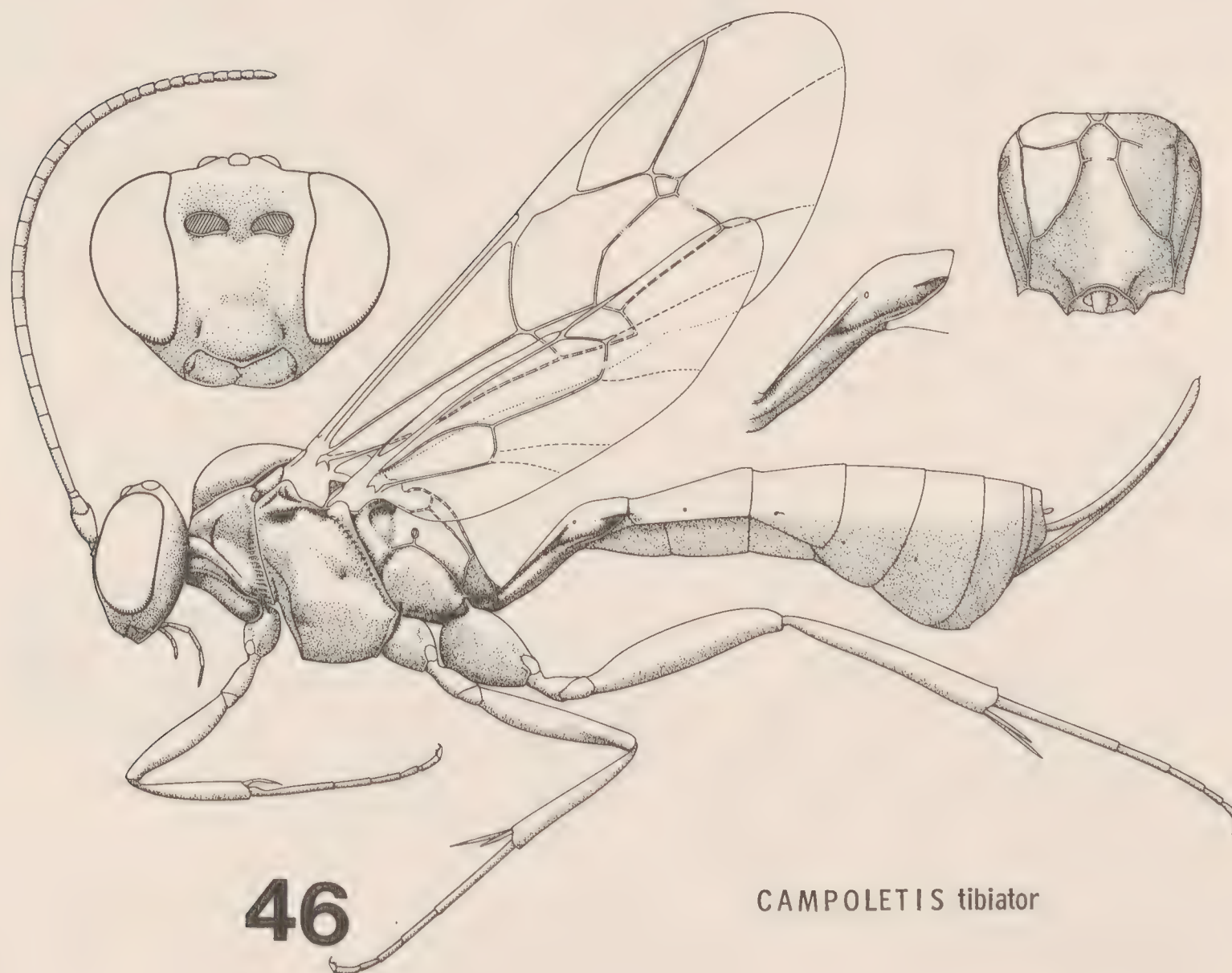
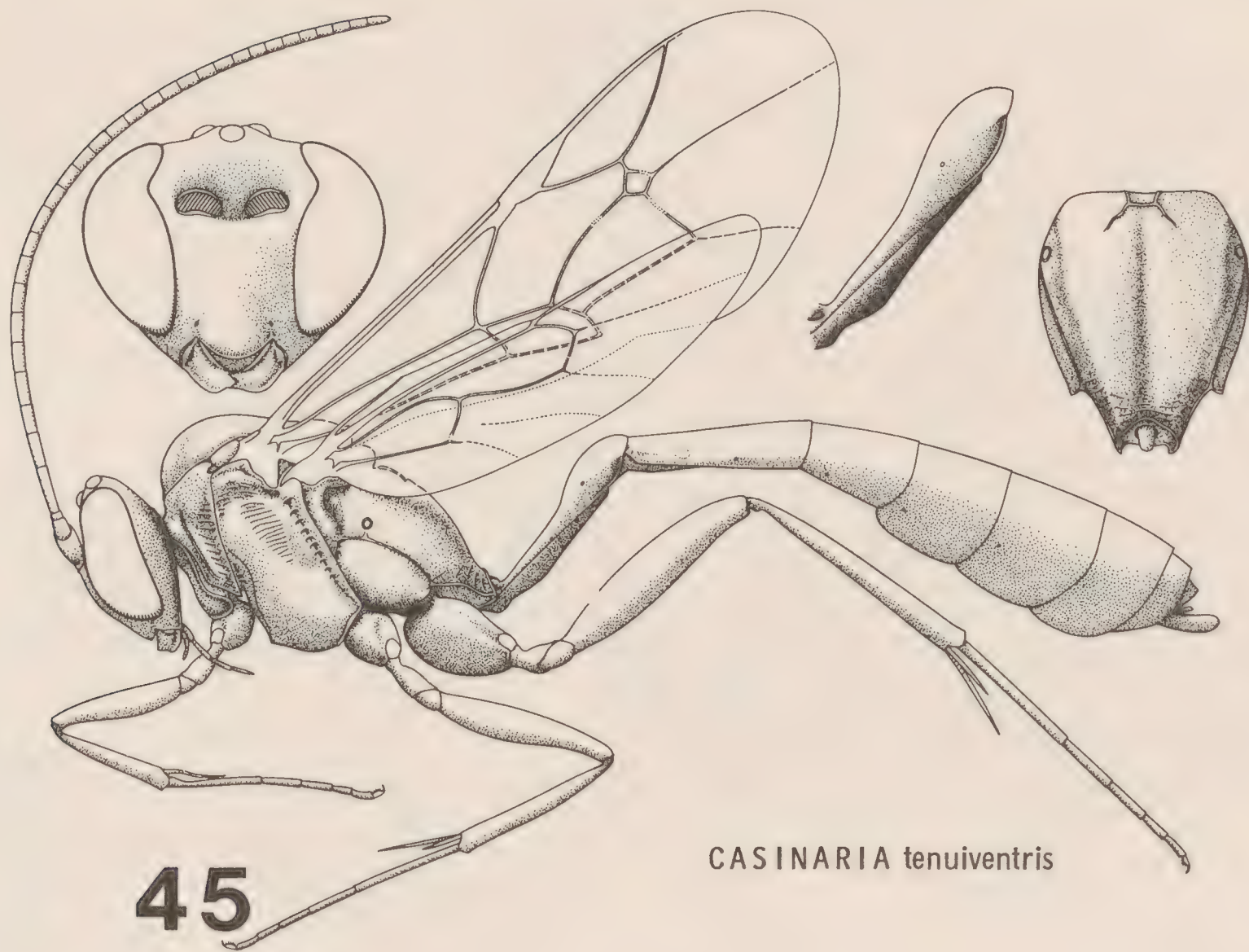
Figs. 31-36. Tergites 2 and 3 of: 31, Coccygomimus turionellae. 32, C. moraguesi. 33, C. instigator. 34, C. disparis. 35, C. pedalis. 36, Itoplectis alternans.



Figs. 37-42. Propodeum of: 37, *Itoplectis alternans*. 38, *I. conquisitor*. Side of thorax of: 39, *I. alternans*. 40, *I. conquisitor*. Tergites 1 to 3 of: 41, *Theronia atalantae*. 42, *I. conquisitor*.



Figs. 43-44. Generic diagrams of: 43, Sinophorus.
44, Campoplex.

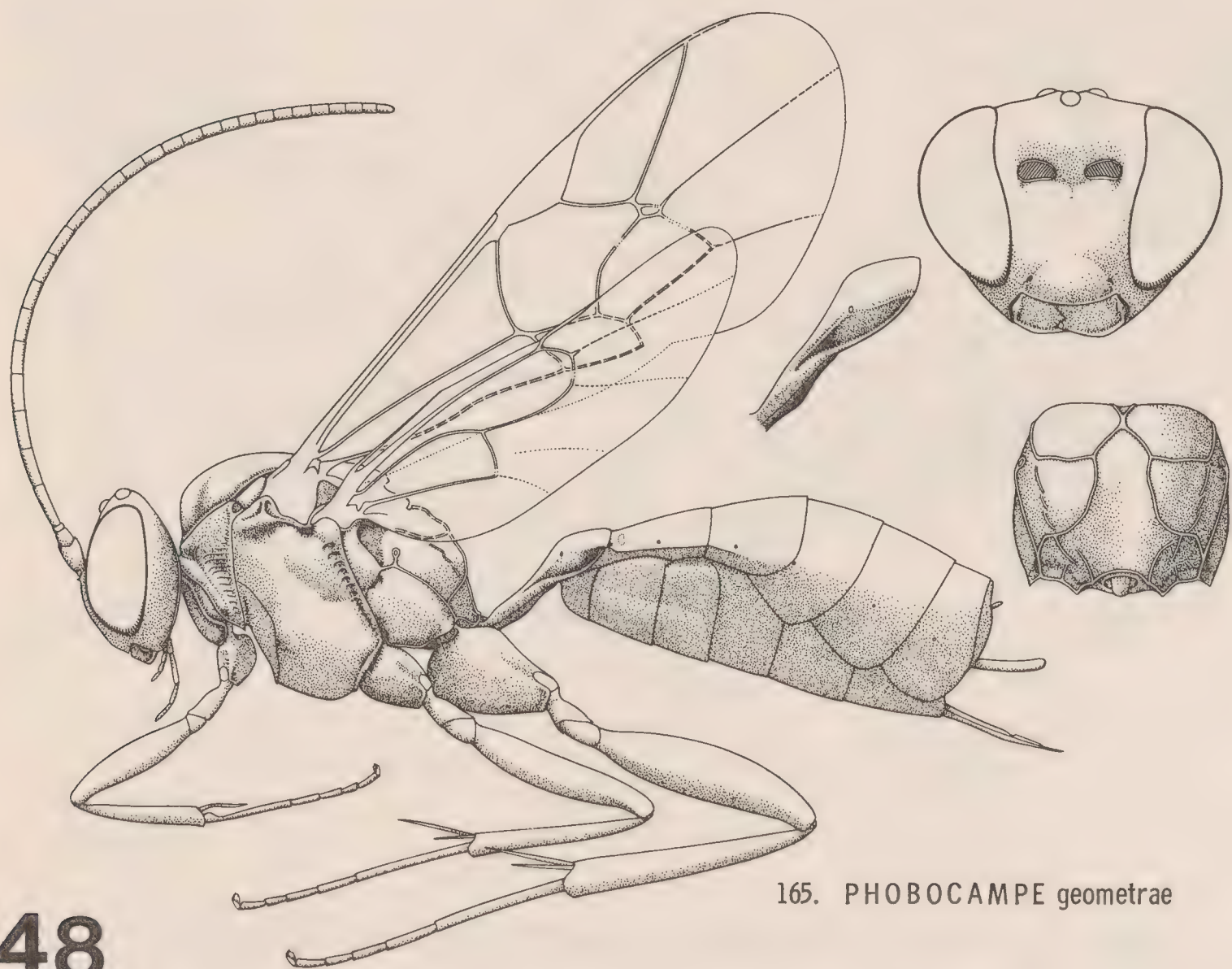


Figs. 45-46. Generic diagrams of: 45, Casinaria.
46. Campoletis.



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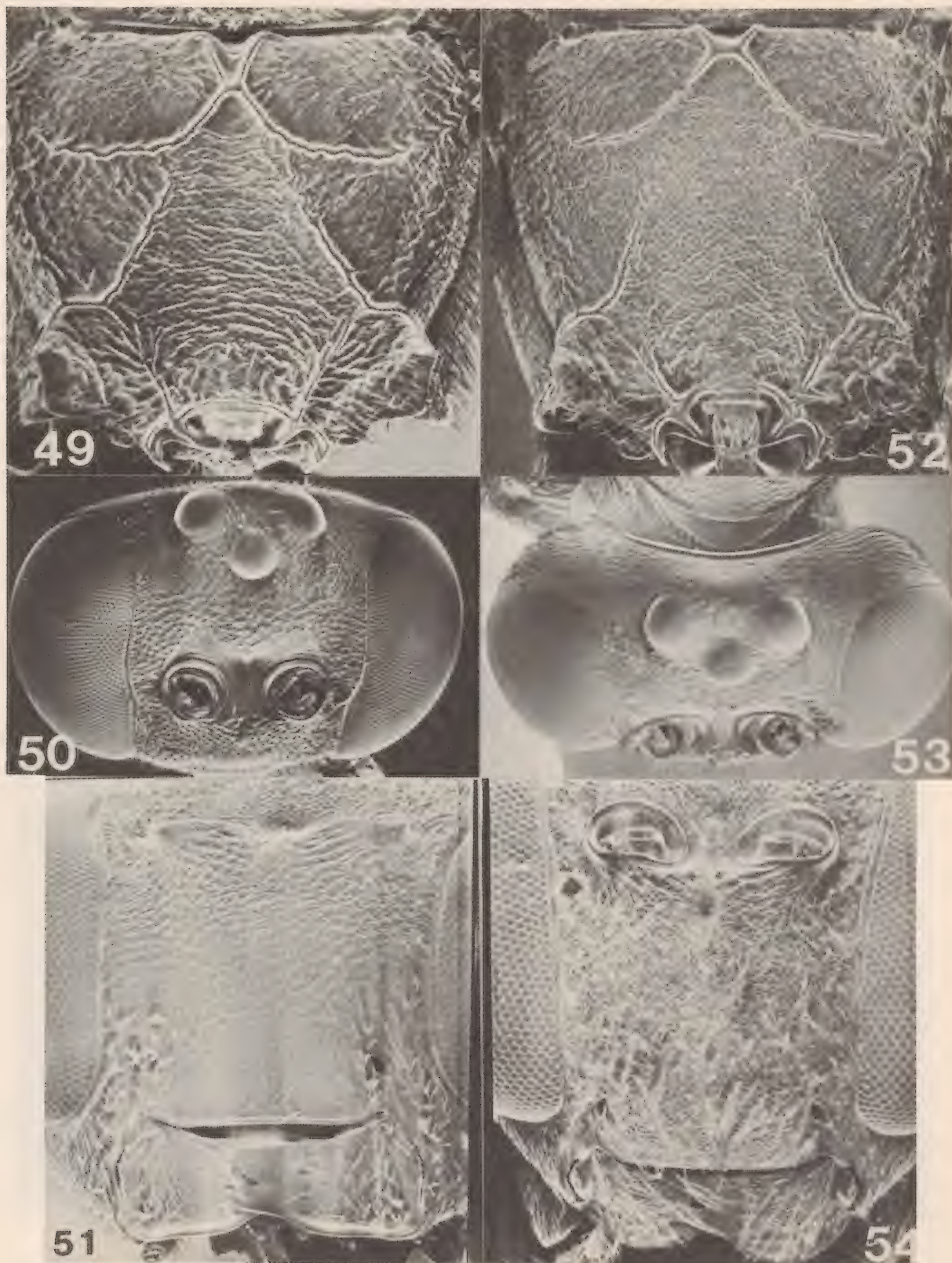
HYPOSOTER synchloae



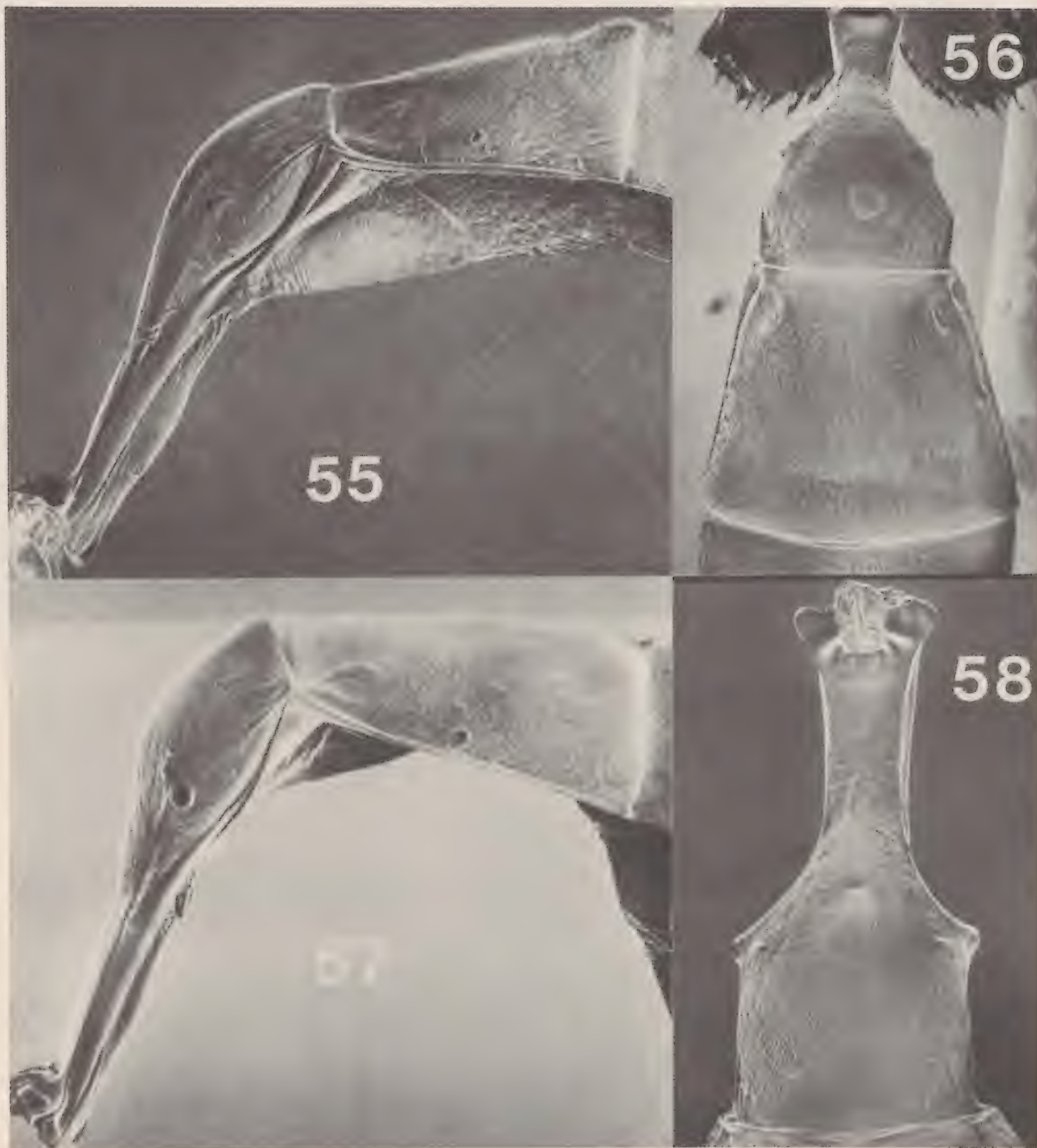
48

165. PHOBOCAMPE geometrae

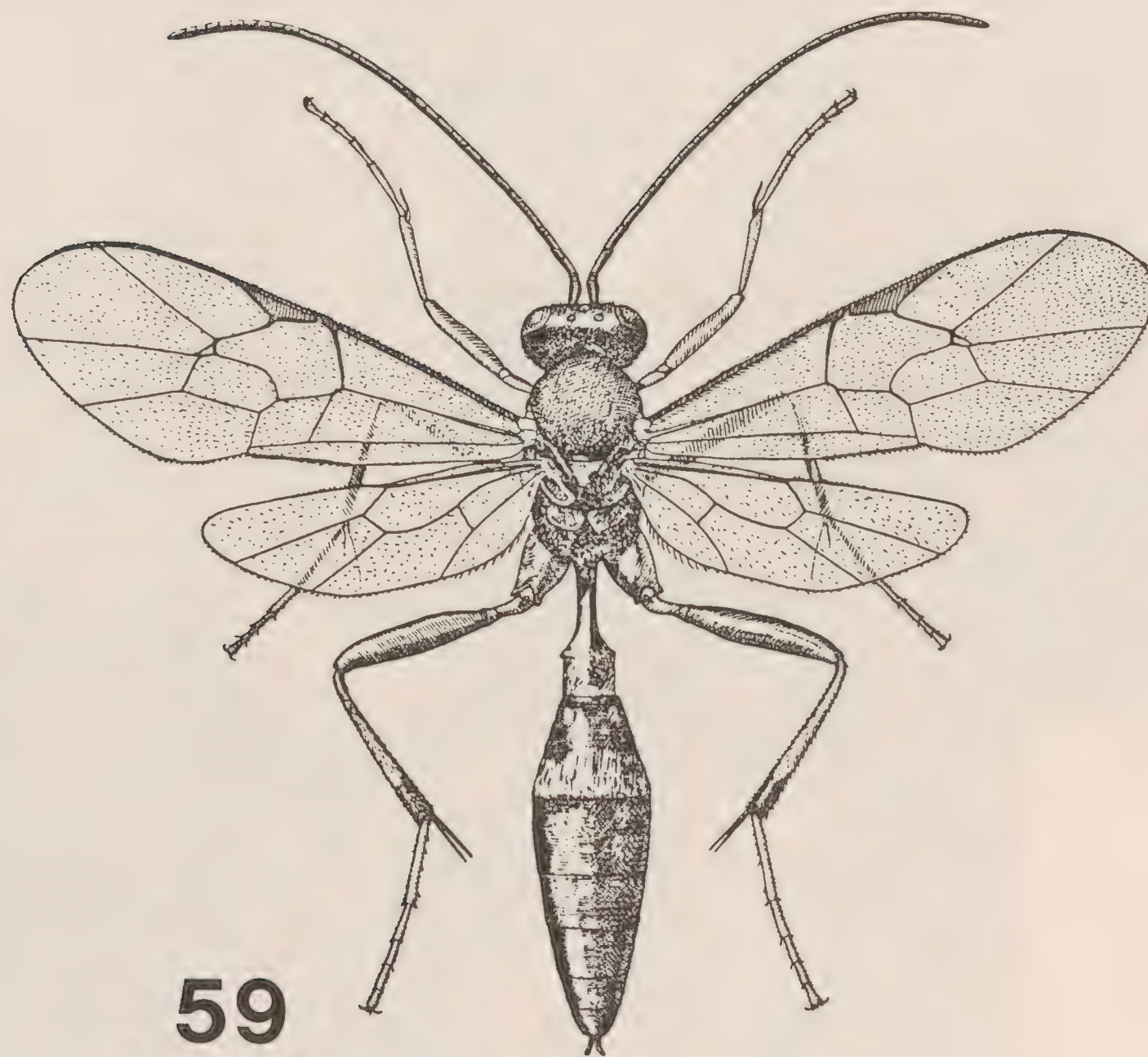
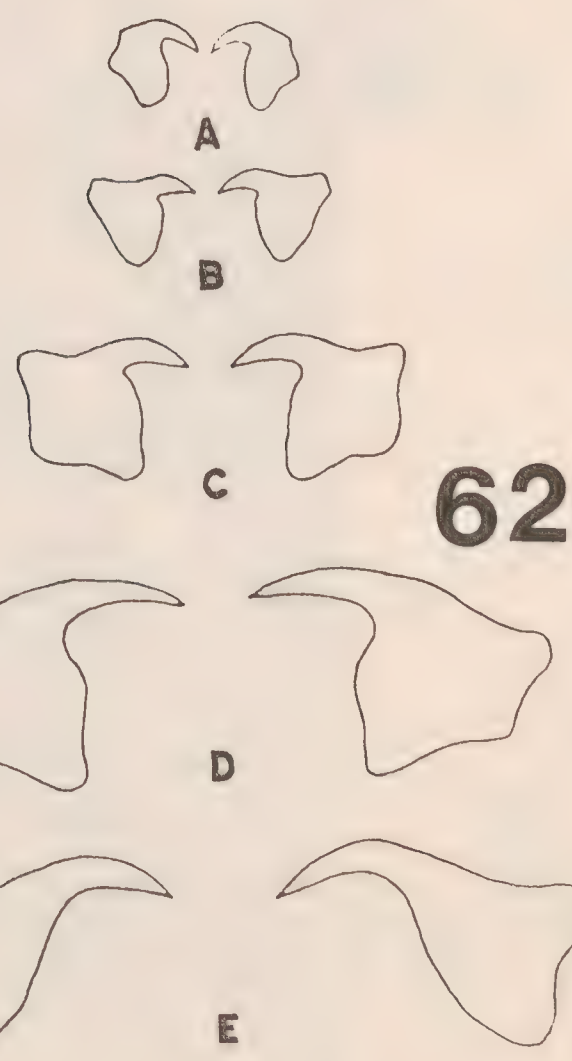
Figs. 47-48. Generic diagrams of: 47, Hyposoter.
48, Phobocampe.



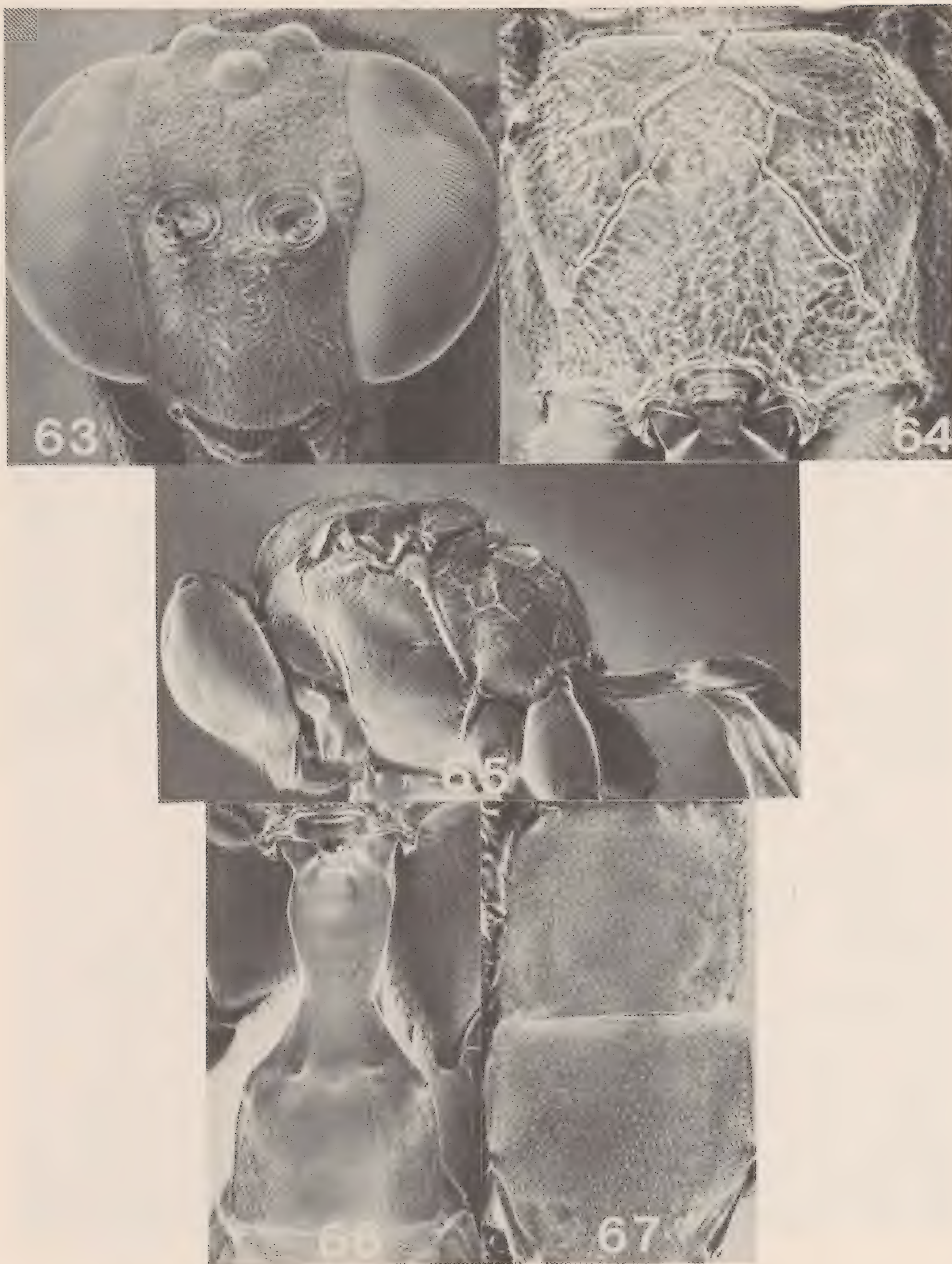
Figs. 49-54. *Phobocampe uncinata*: 49, Propodeum. 50, Vertex. 51, Face. *P. lymantriae*: 52, Propodeum. 53, Vertex. 54, Face.



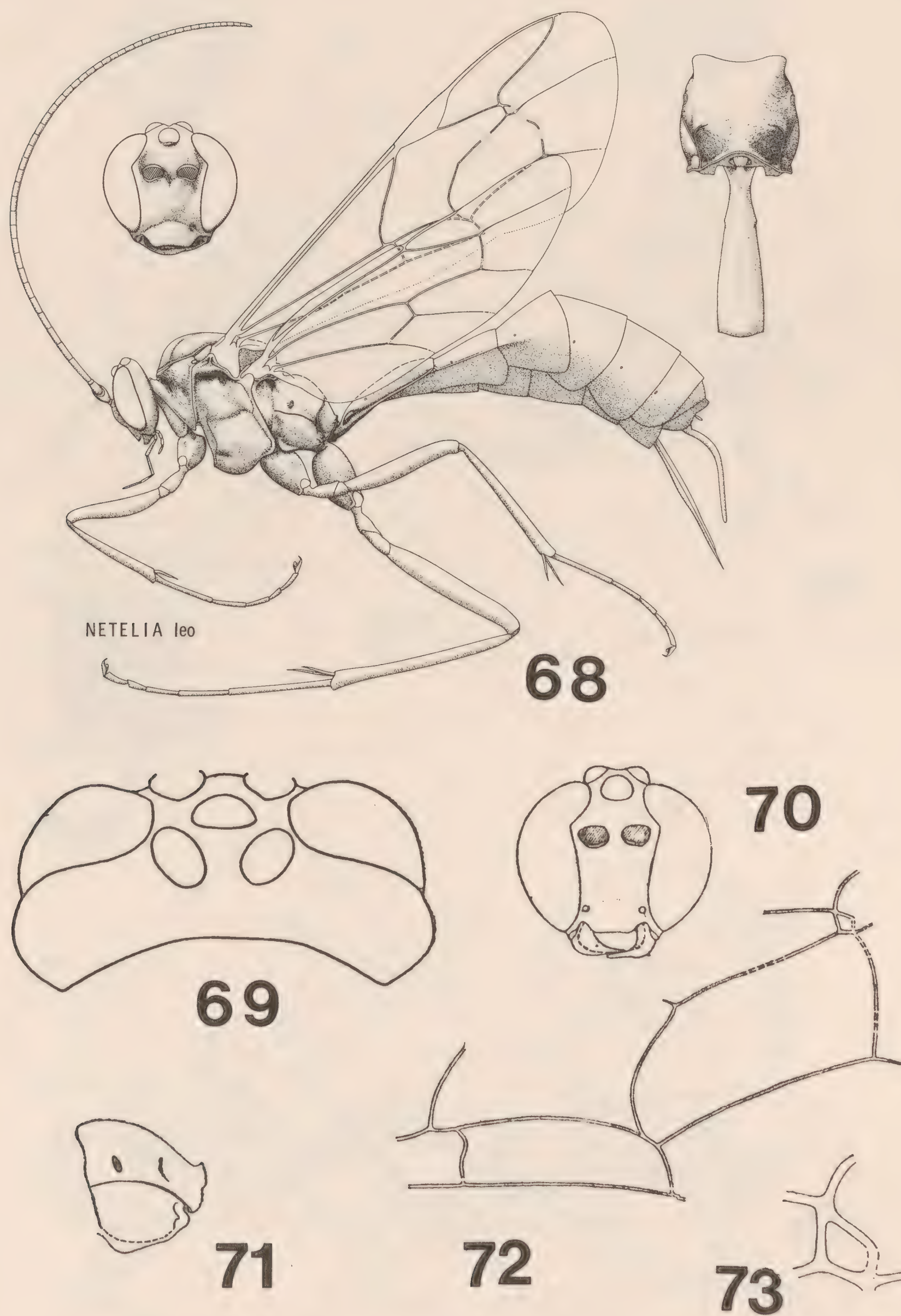
Figs. 55-58. Phobocampe lymantriae, tergites 1-2: 55, side view. 56, Dorsal view. P. uncinata, tergites 1-2: 57, side view. 58, Dorsal view.

**59****60****61****62**

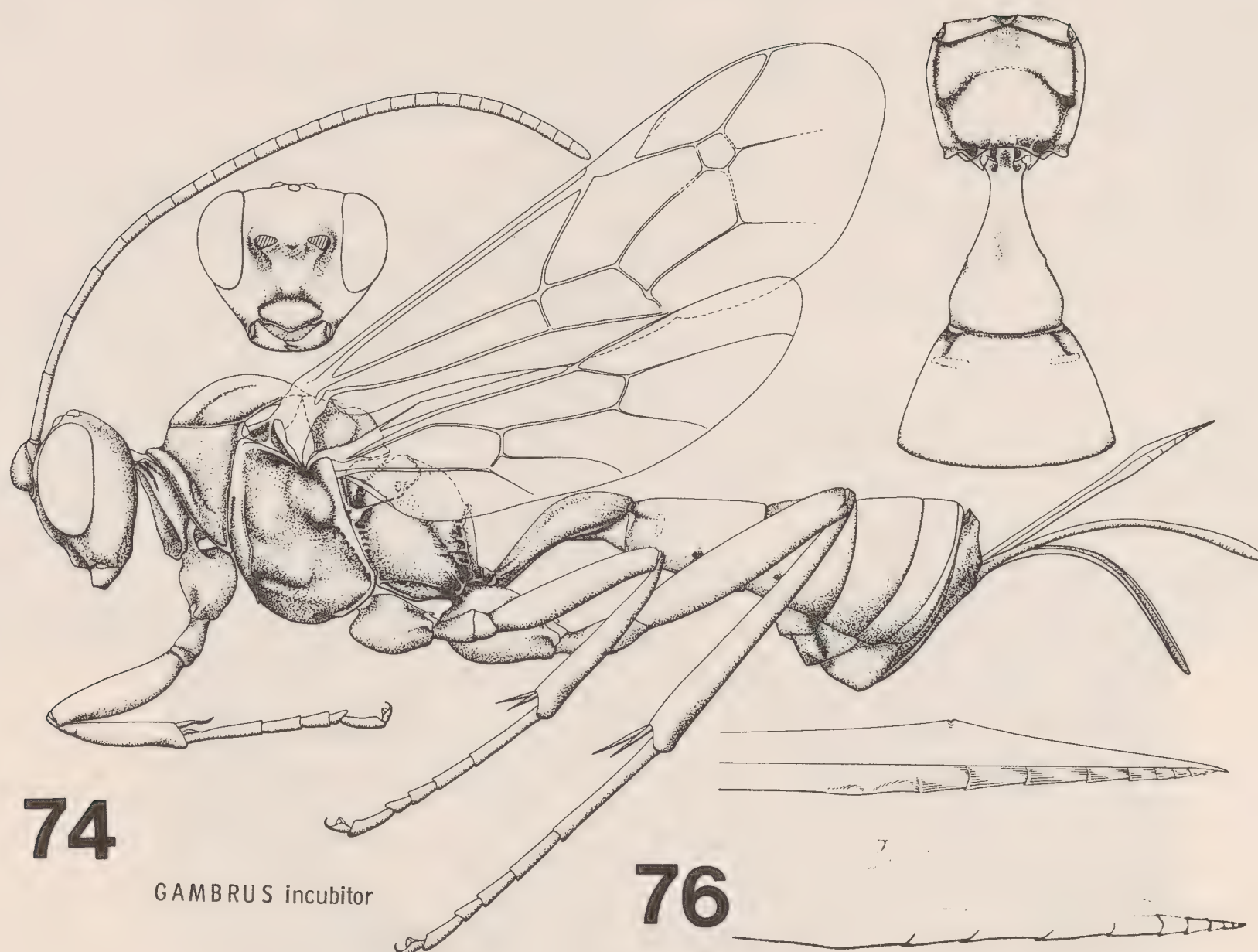
Phobocampe uncinata: 59, Adult. 60, Egg. 61, Cocoon. 62, Larval mandibles, A-E. First to fifth instars.



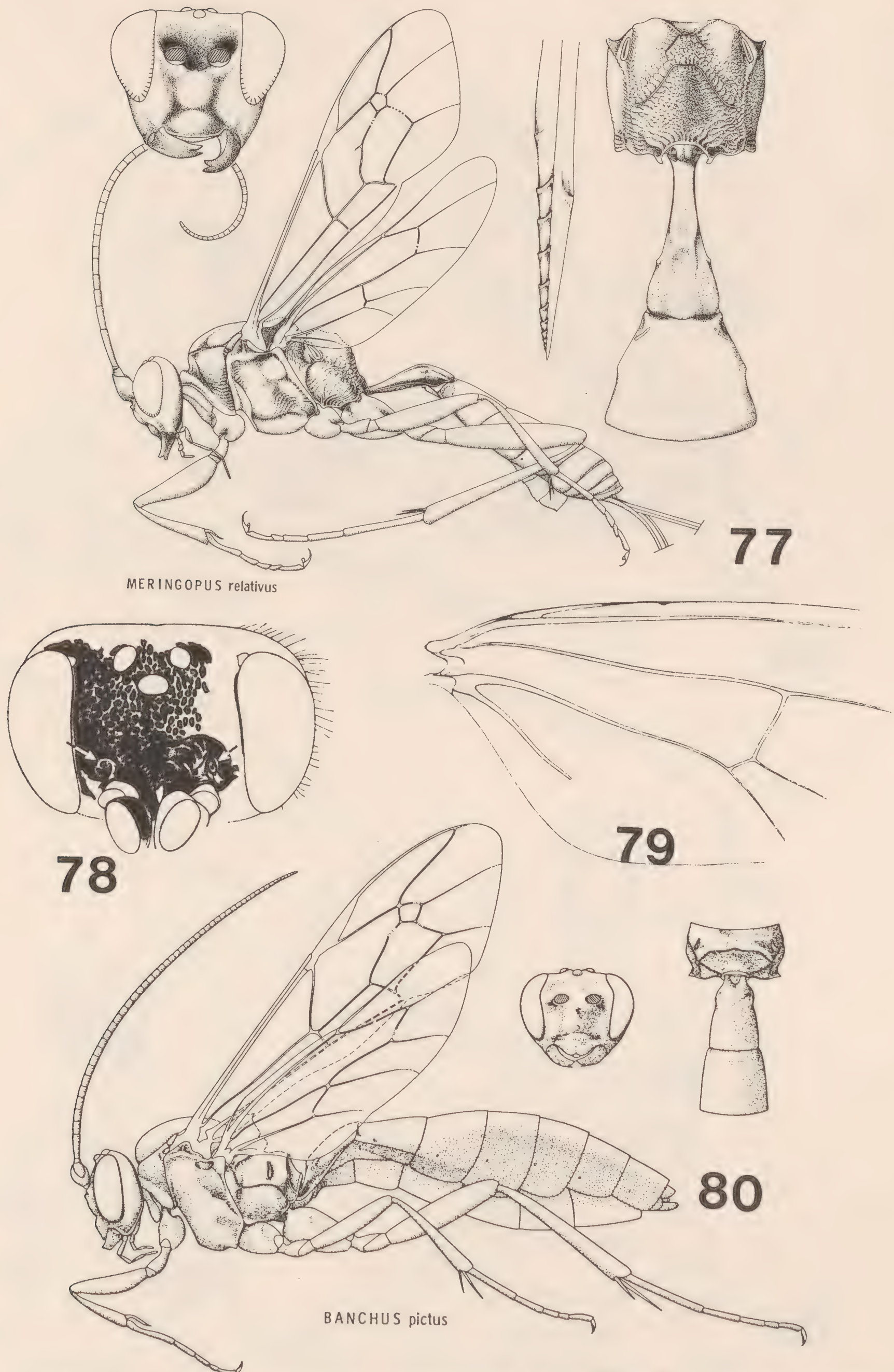
Figs. 63-67. *Hyposoter tricoloripes*: 63, Face. 64, Propodeum. 65, Thorax. 66, Tergite 1. 67, Tergites 2-3.



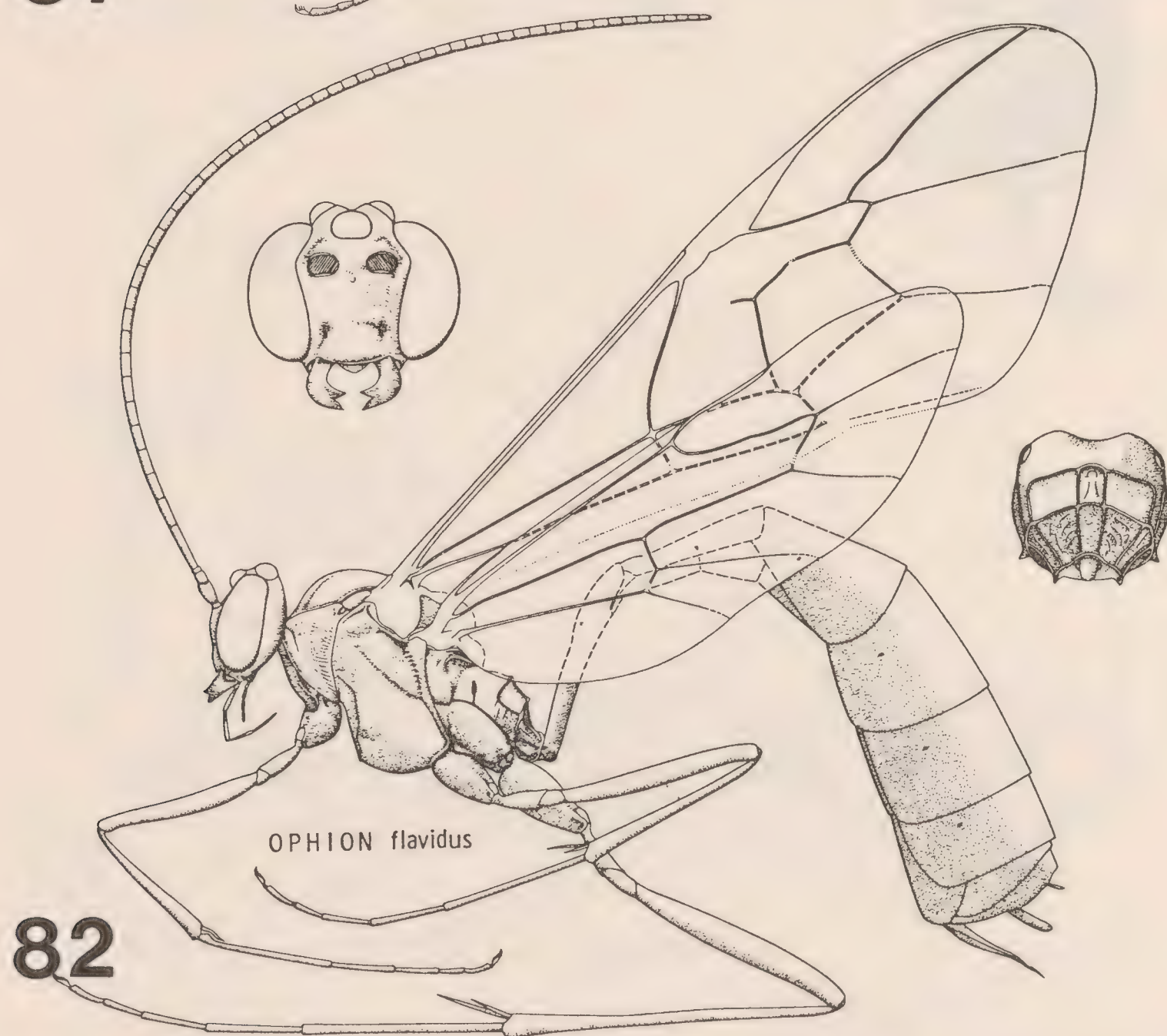
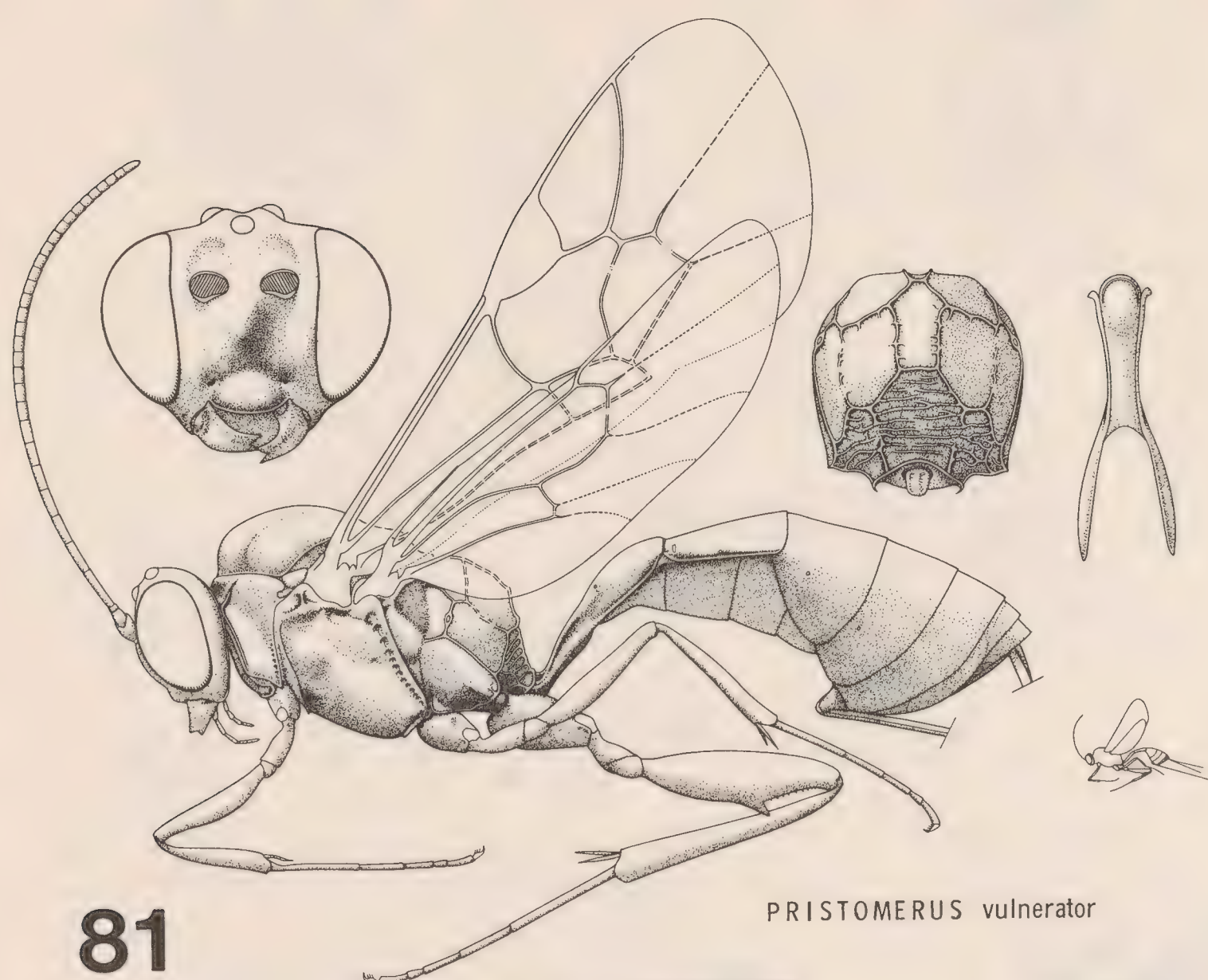
Figs. 68-73. 68, Generic diagram of Netelia.
N. vinulae: 69, Vertex. 70, Head, front view.
 71, Propodeum. 72, Part of front wing. 73, Areolet.



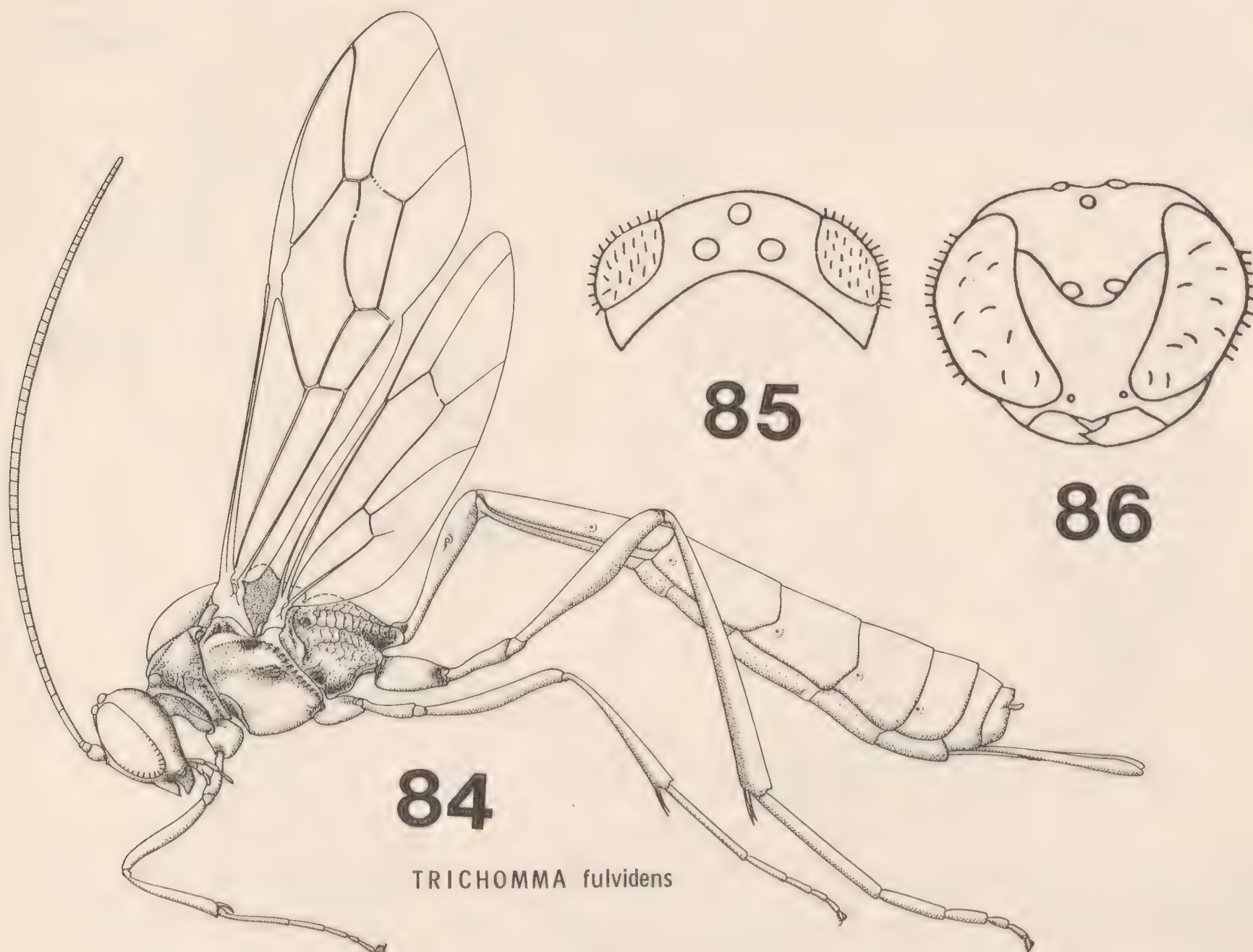
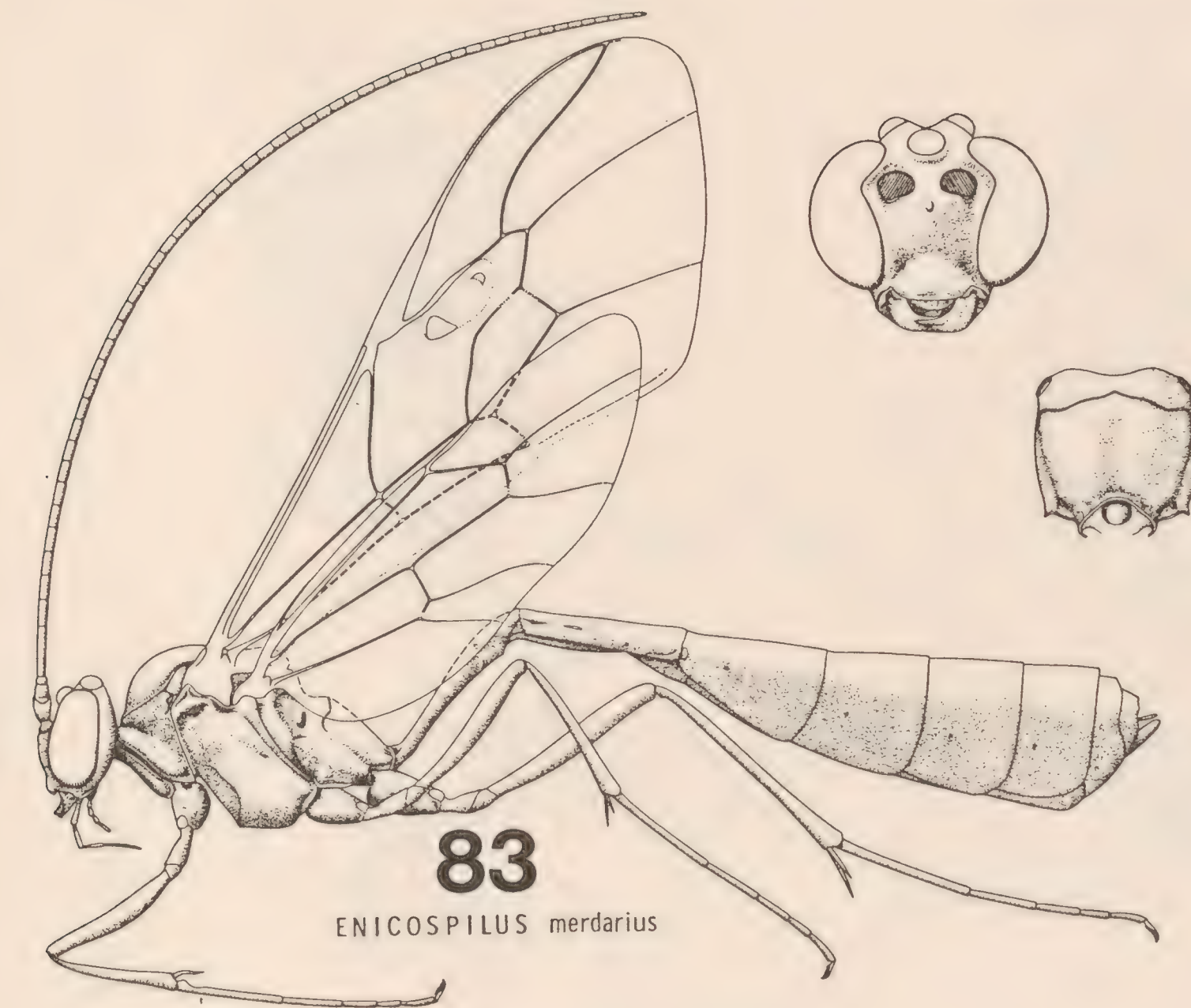
Figs. 74-76. Generic diagrams of: 74, Gambrus. 75, Ischnus. 76, Ovipositor tip of G. amoenus.



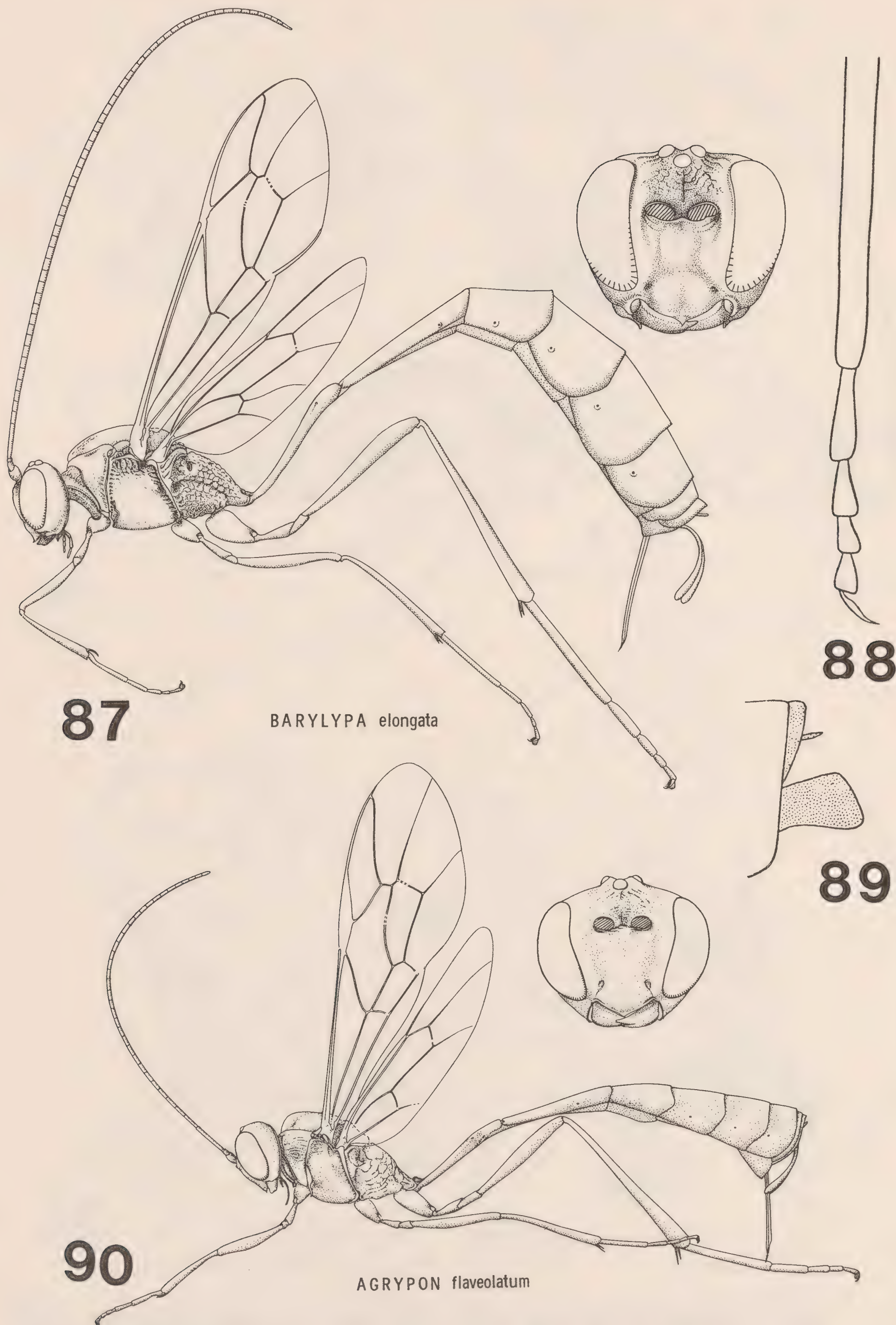
Figs. 77-80. 77, Generic diagram of Meringopus. 78, M. cyanator, head. 79, Hind wing of same. 80, Generic diagram of Banchus.



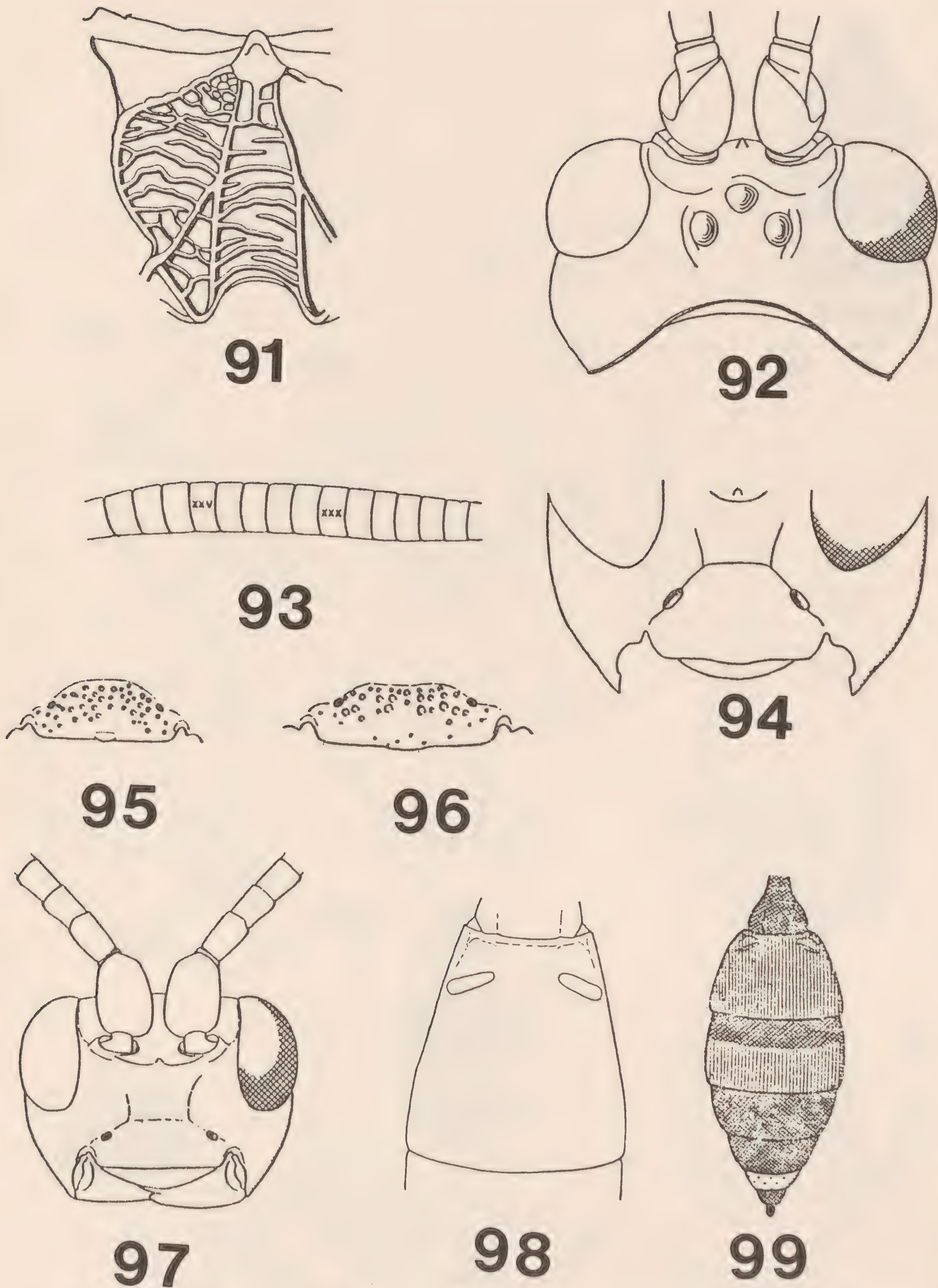
Figs. 81-82. Generic diagrams of: 81, Pristomerus.
82, Ophion.



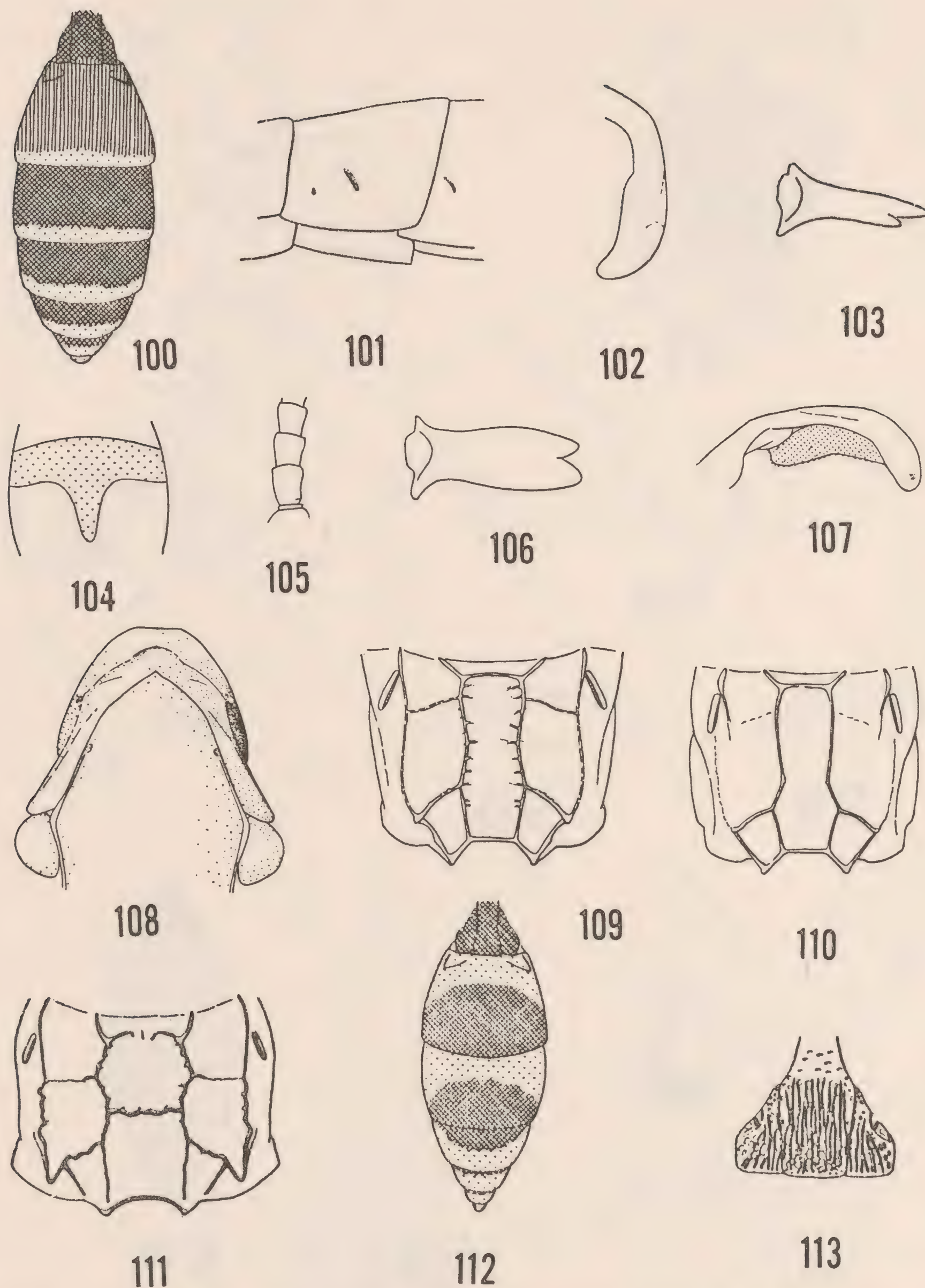
Figs. 83-86. Generic diagrams of: 83, Enicospilus. 84, Trichomma. T. enecator: 85, Vertex. 86, Face.



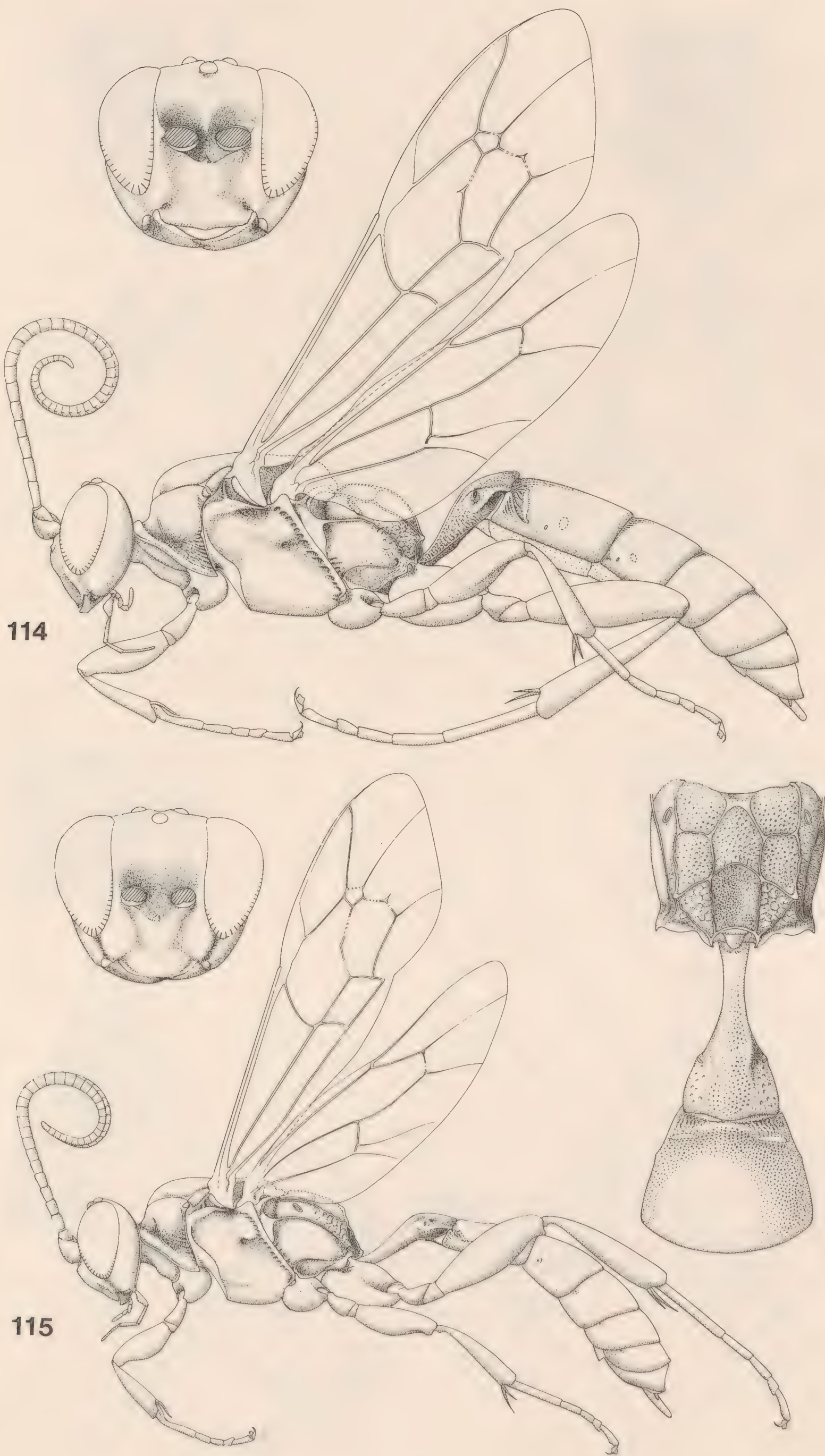
Figs. 87-90. Generic diagram: 87, Barylypa. 88, Hind tarsus B. delictor. 89, Male clasper, B. delictor. Generic diagram: 90, Agrypon.



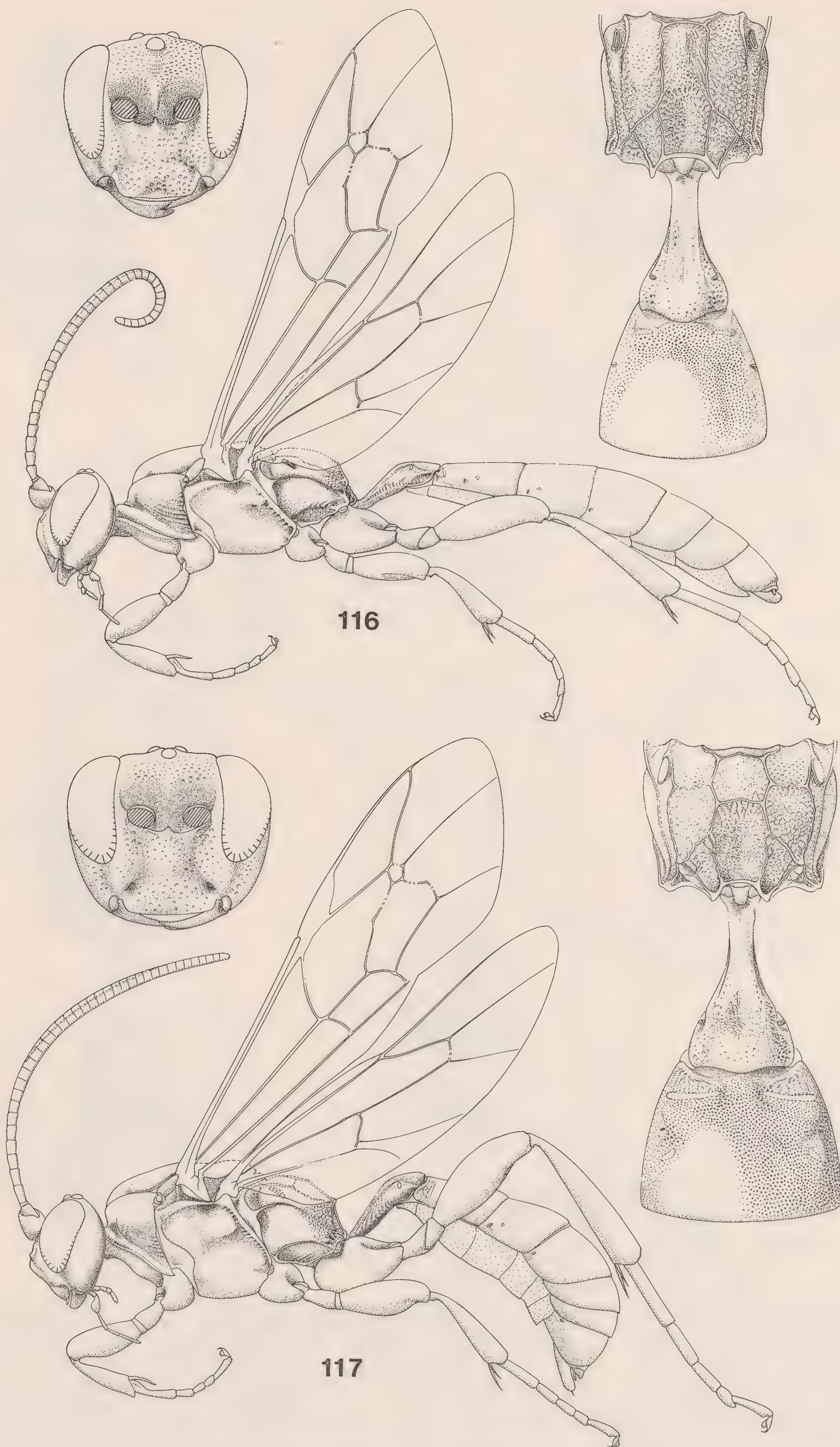
Figs. 91 - 99. Callajoppa cirrogaster: 91, Propodeum. 92, Vertex. 93, Flagellar segments. 94, Clypeus. Melanichneumon leucocheilus: 95, Clypeus, male. 96, Clypeus, female. 97, Head. 98, Tergite 2, 99. Pterocormus sarcitorius, abdomen color.



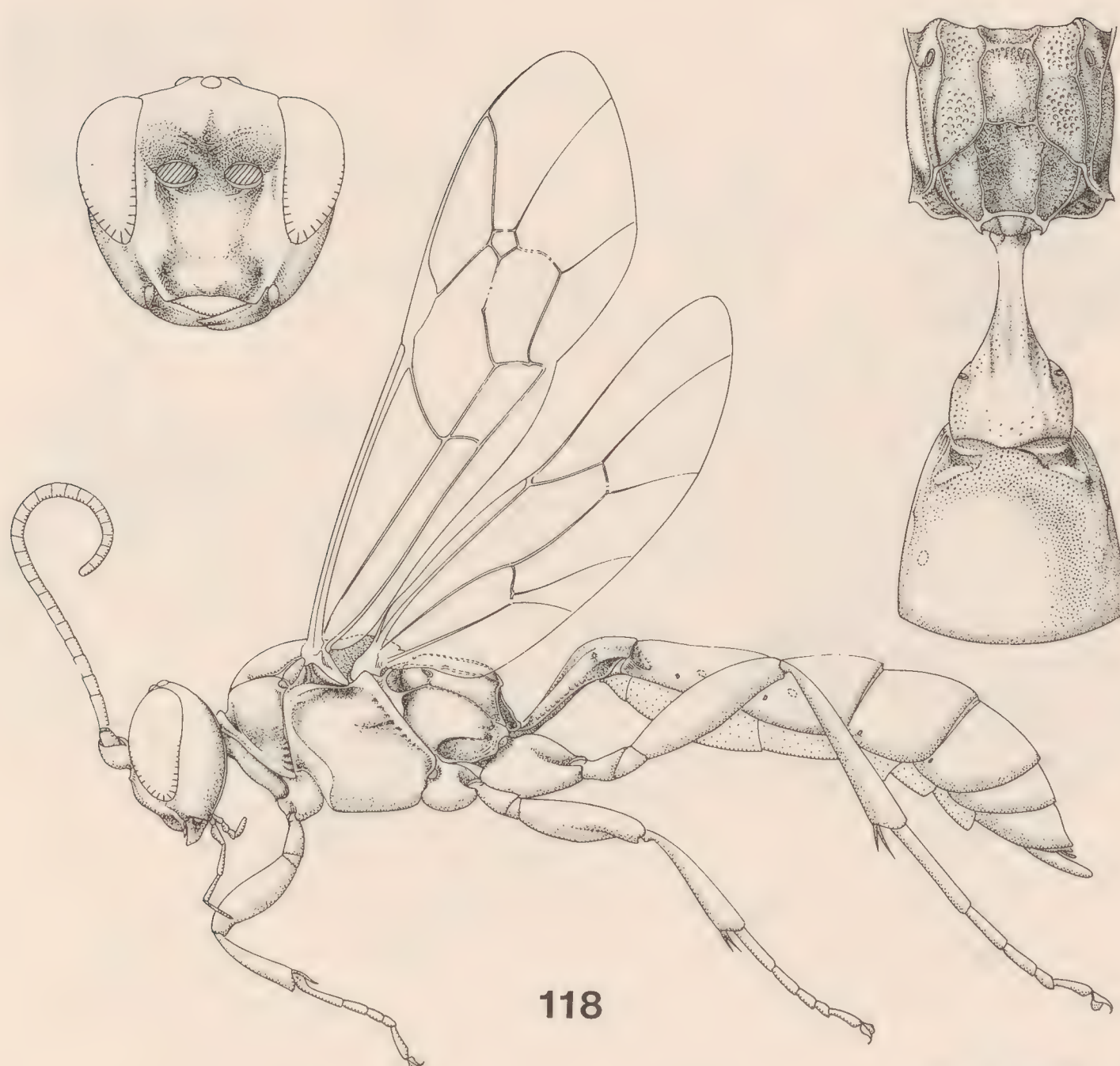
Figs. 100-113. Triptognathus amatorius: 100, Abdomen color. 101, Tergites 2-3. 102, Male penis valve. 103, Mandible. Spilichneumon occisor: 104, Hypopygium. 105, Basal flagellar segments. 106, Mandible. 107, Penis valve. 108, Pronotum. 109, Male propodeum. 110, Female propodeum. Amblyteles armatorius: 111, Propodeum. 112, Abdomen. Pterocormus sarcitorius: 113, Postpetiole.



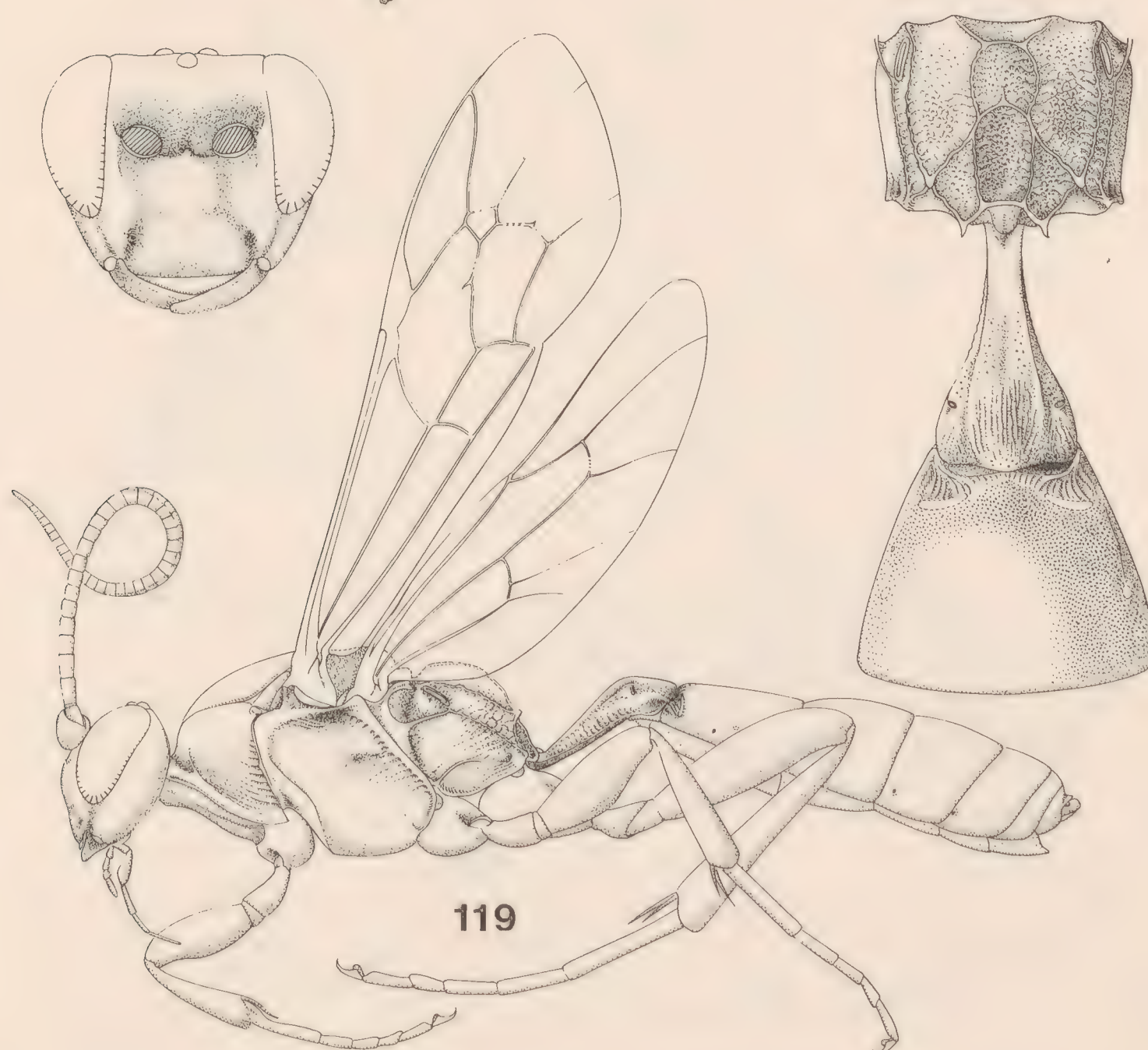
Figs. 114-115. Generic diagrams of: 114, Ichneumon. 115, Melanichneumon.



Figs. 116-117. Generic diagrams of: 116, Spilichneumon. 117, Cratichneumon.

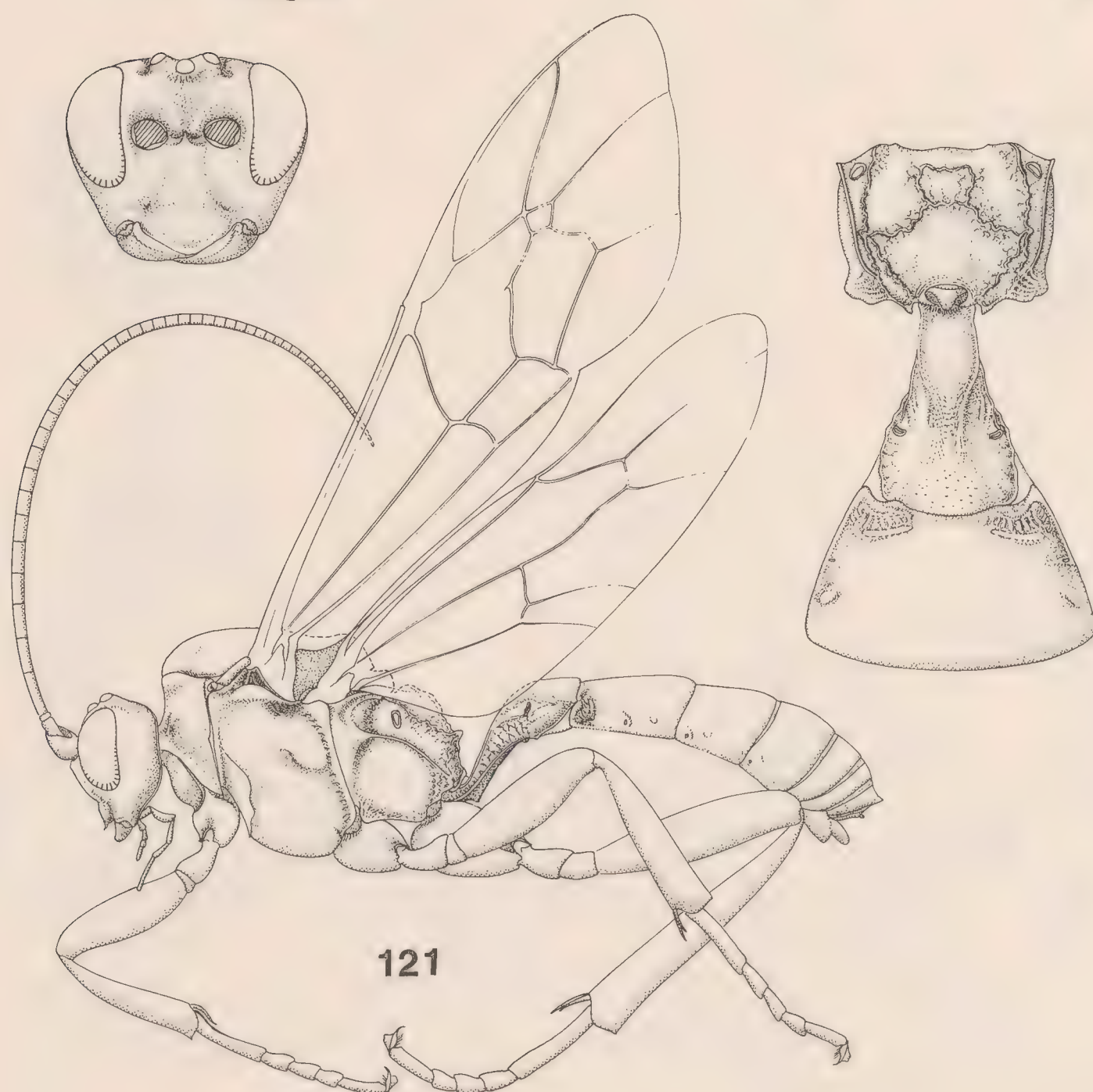
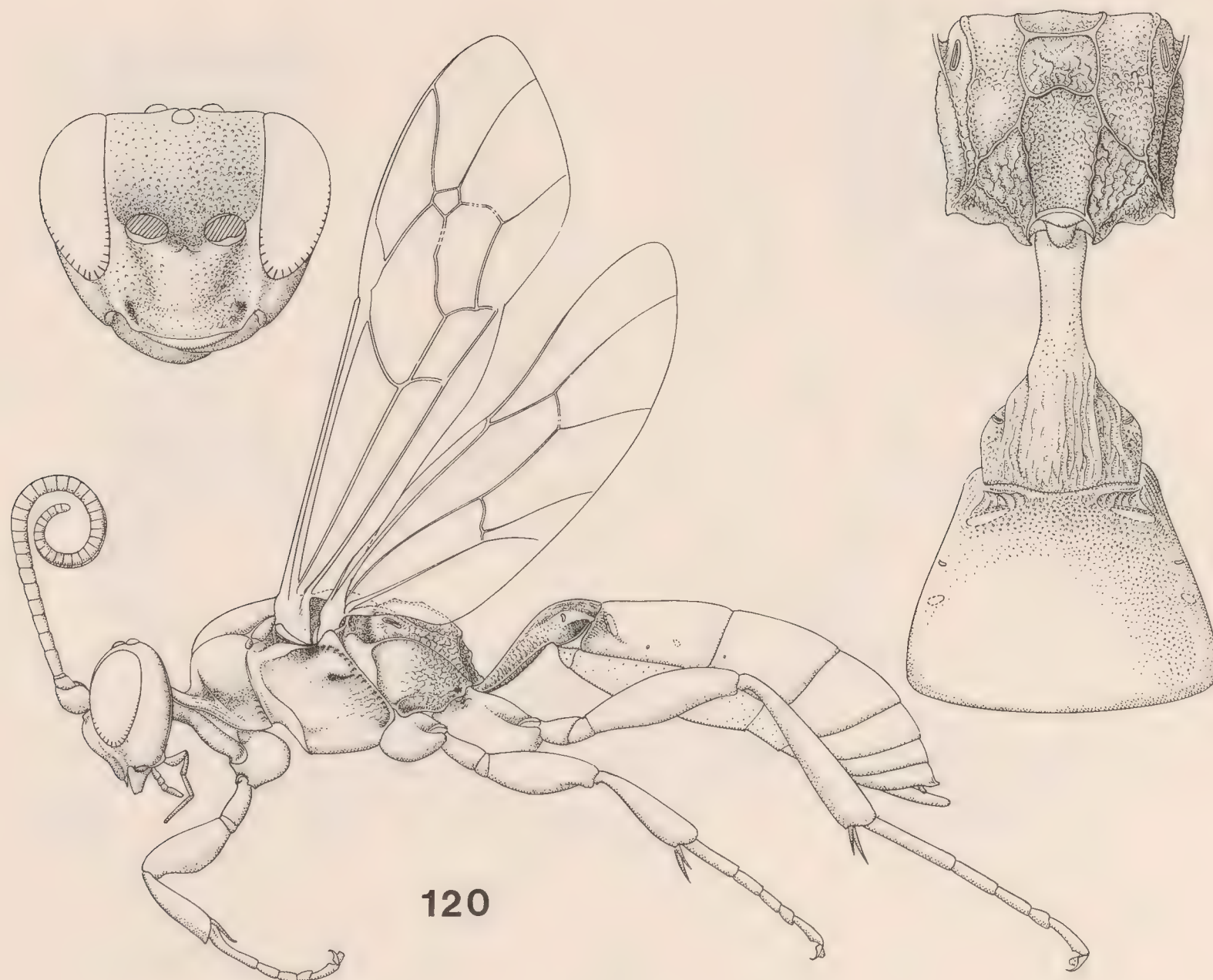


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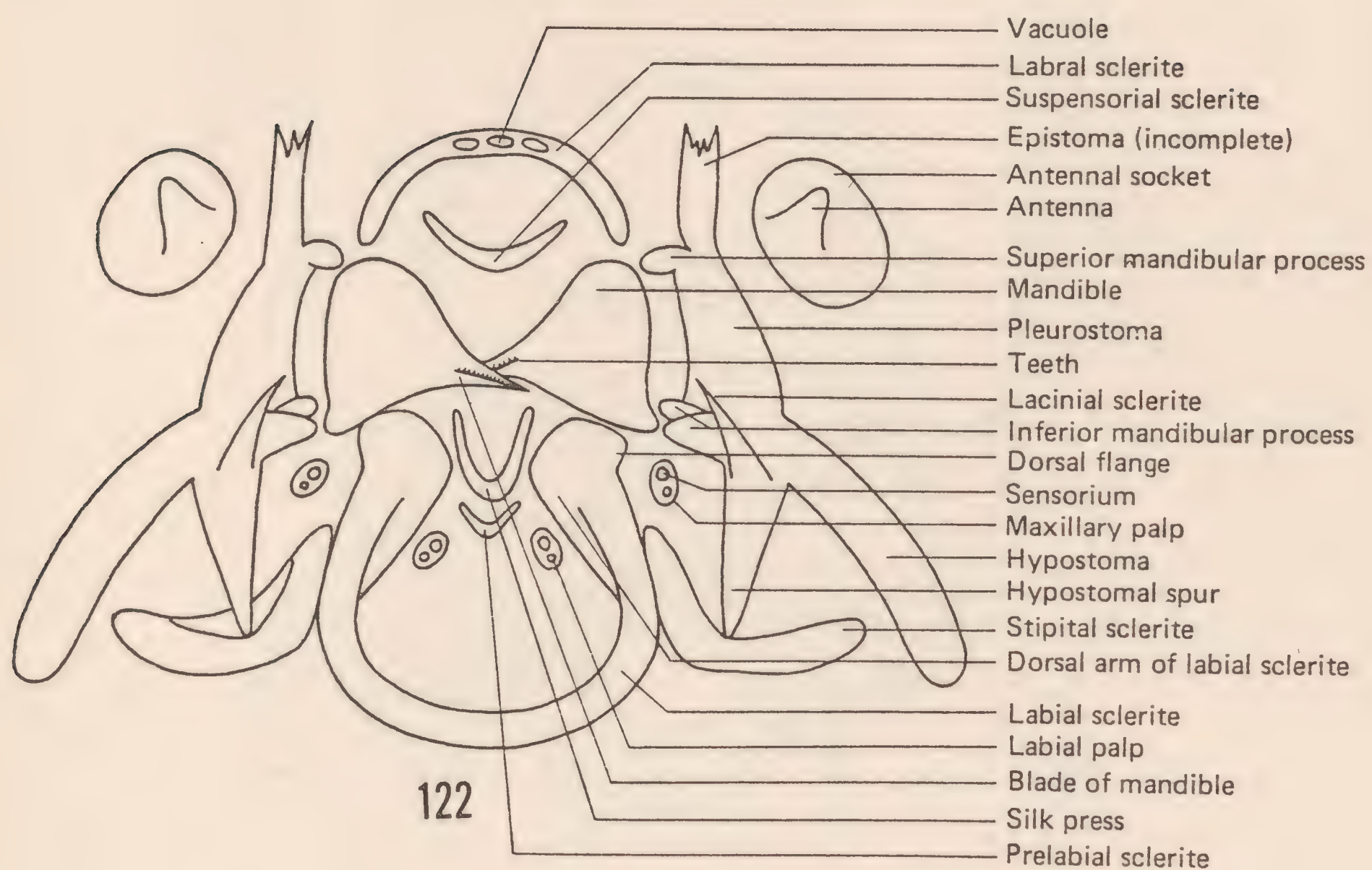


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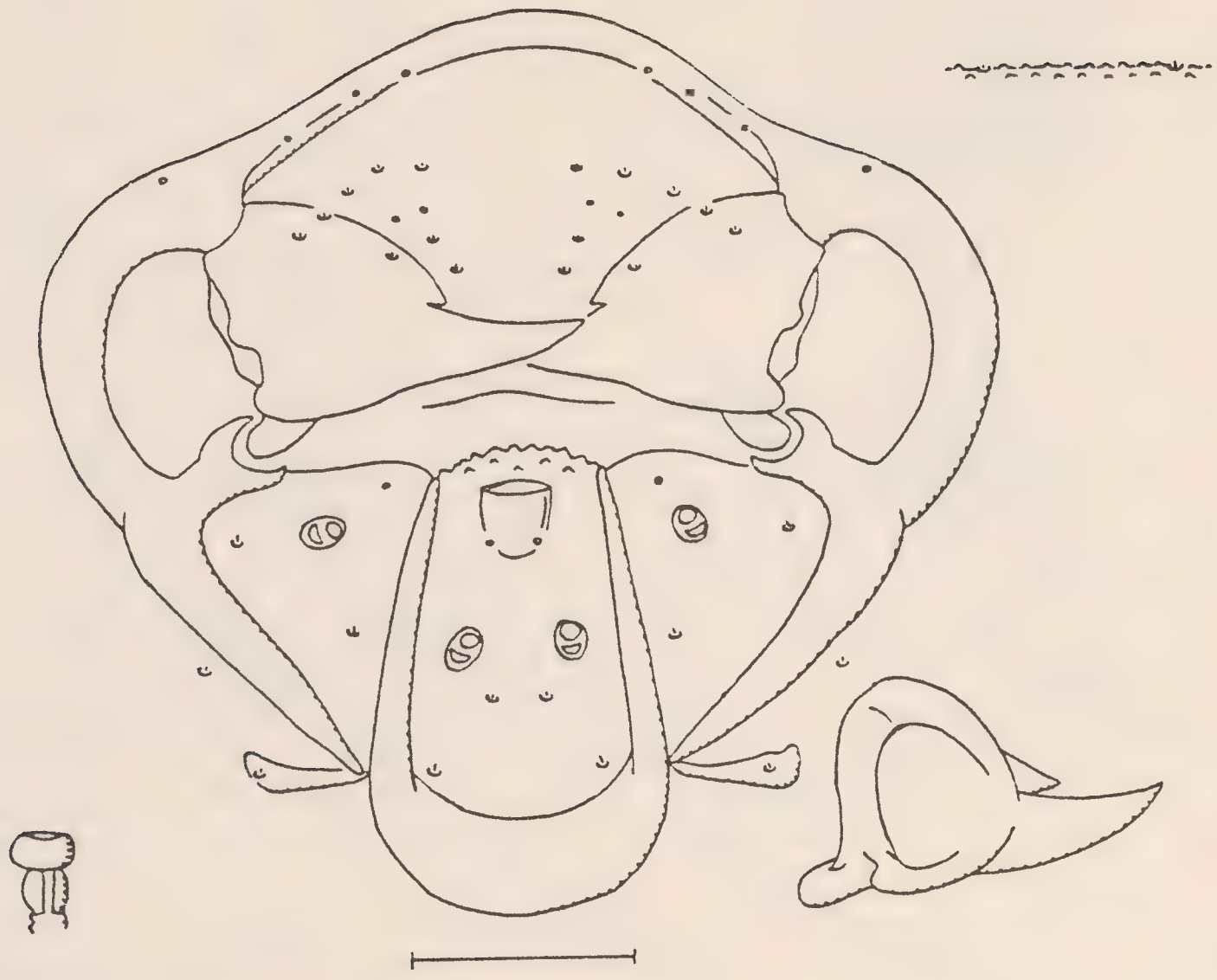
Figs. 118-119. Generic diagrams of: 118, Chasmias. 119, Triptognathus.



Figs. 120-121. Generic diagrams of: 120, Pterocormus. 121, Cotiheresiarches.

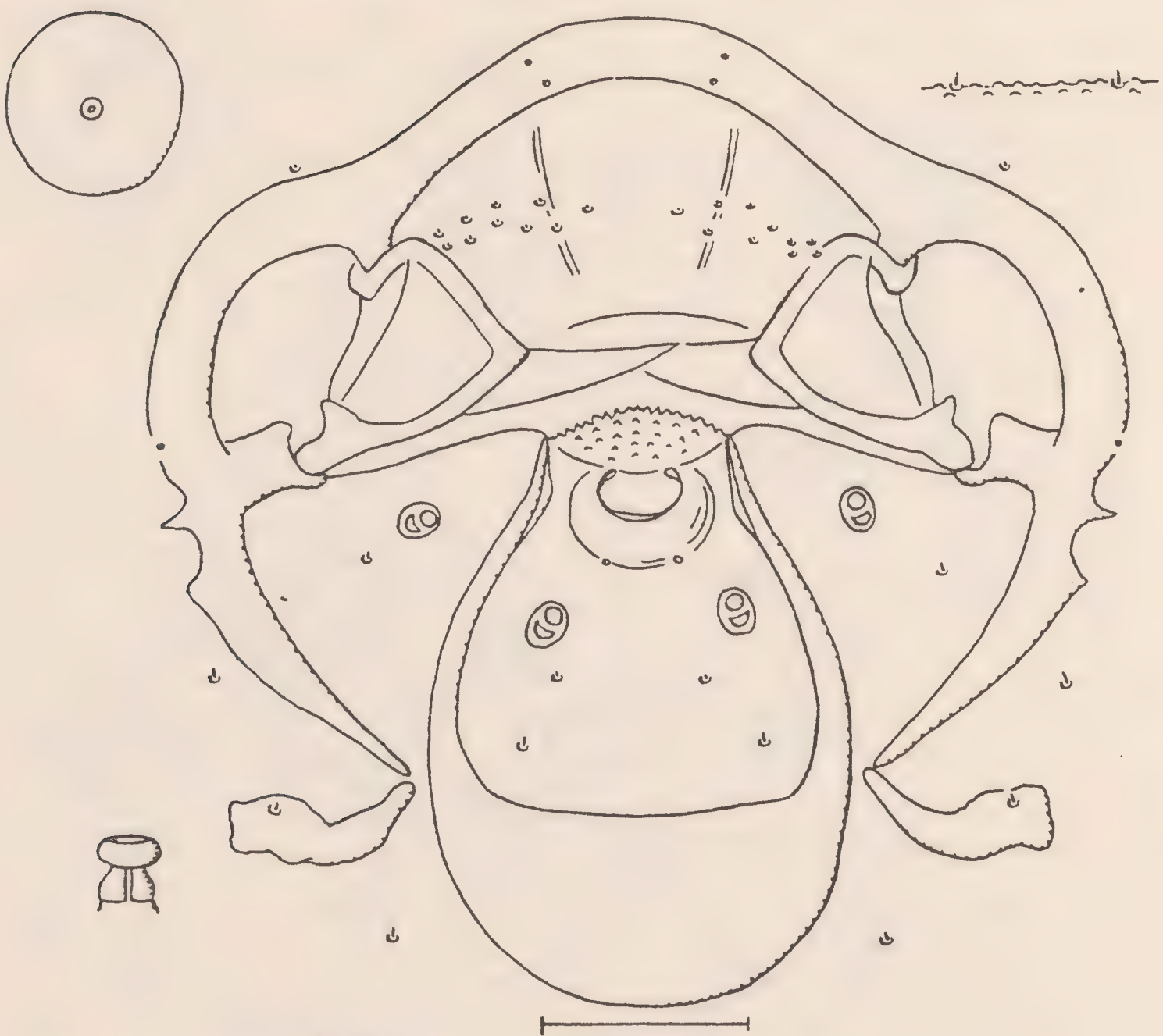


Figs. 122-123. 122, Nomenclature of cephalic sclerites of the ichneumonid larval head. 123, Larval head of Coccygomimus pedalis.



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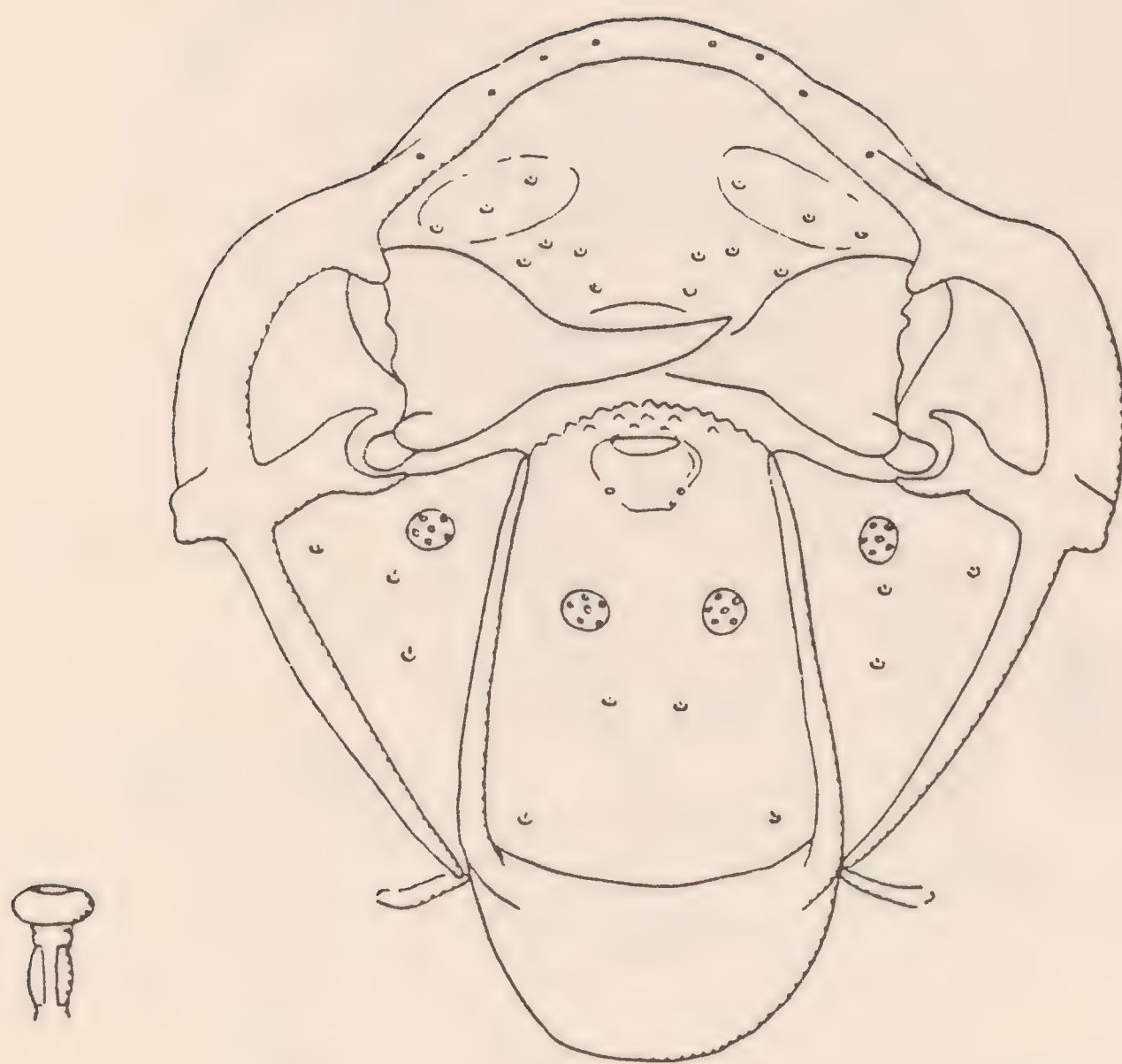
Coccygomimus turionellae with posterior view of left mandible



125

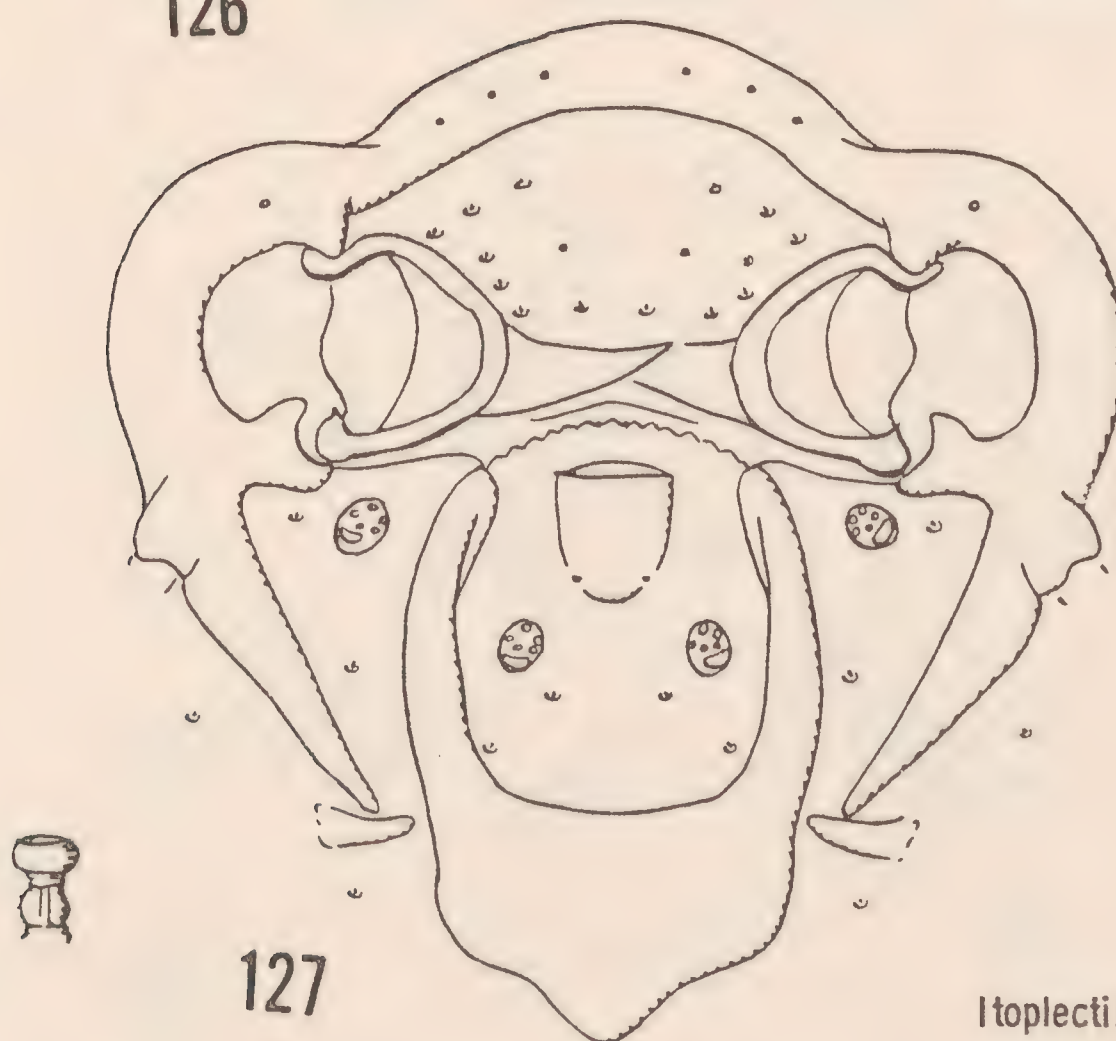
Coccygomimus spurius

Figs. 124-125. Larval head of : 124: Coccygomimus turionellae. 125, C. spurius.



126

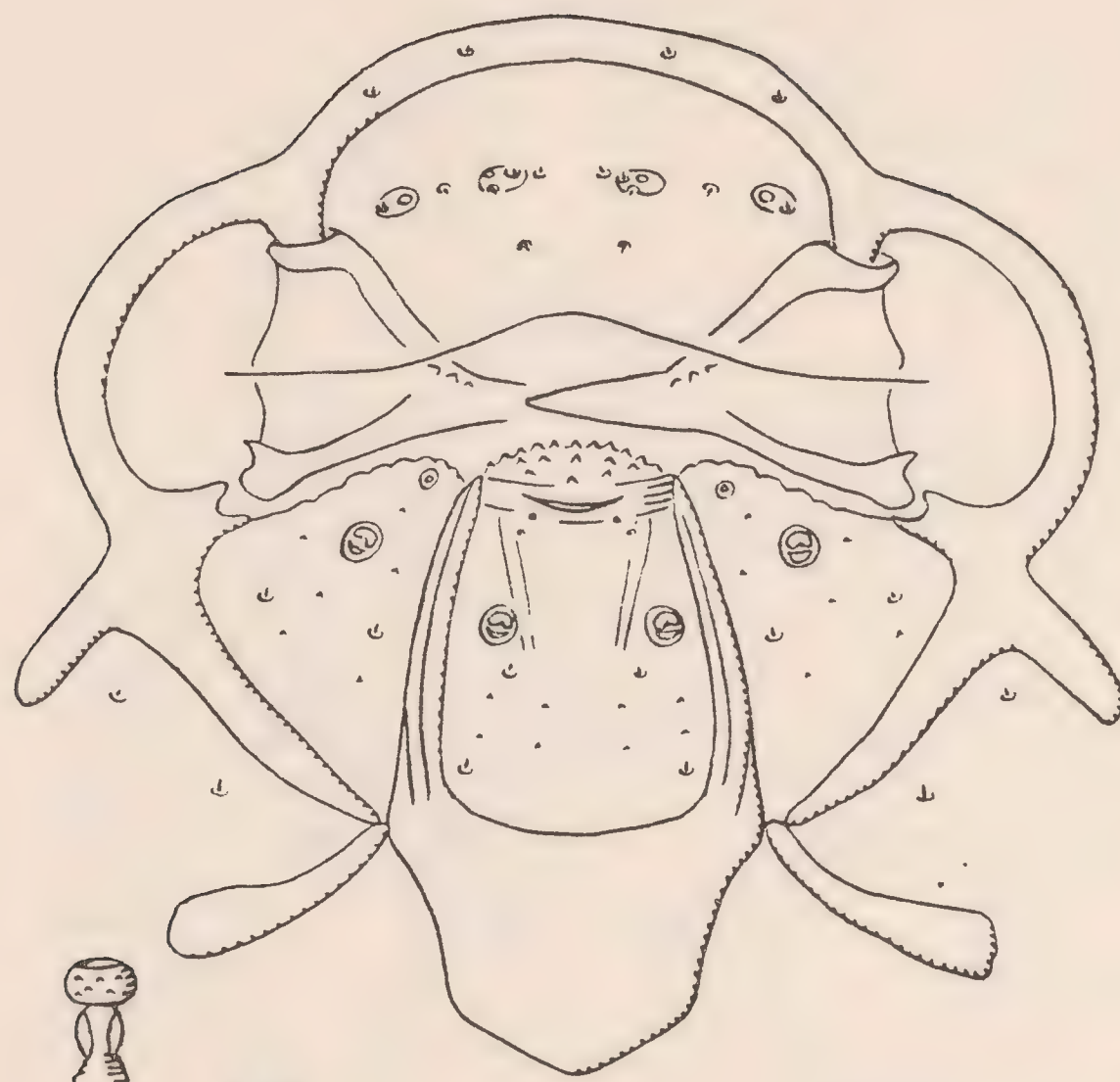
Itoplectis alternans



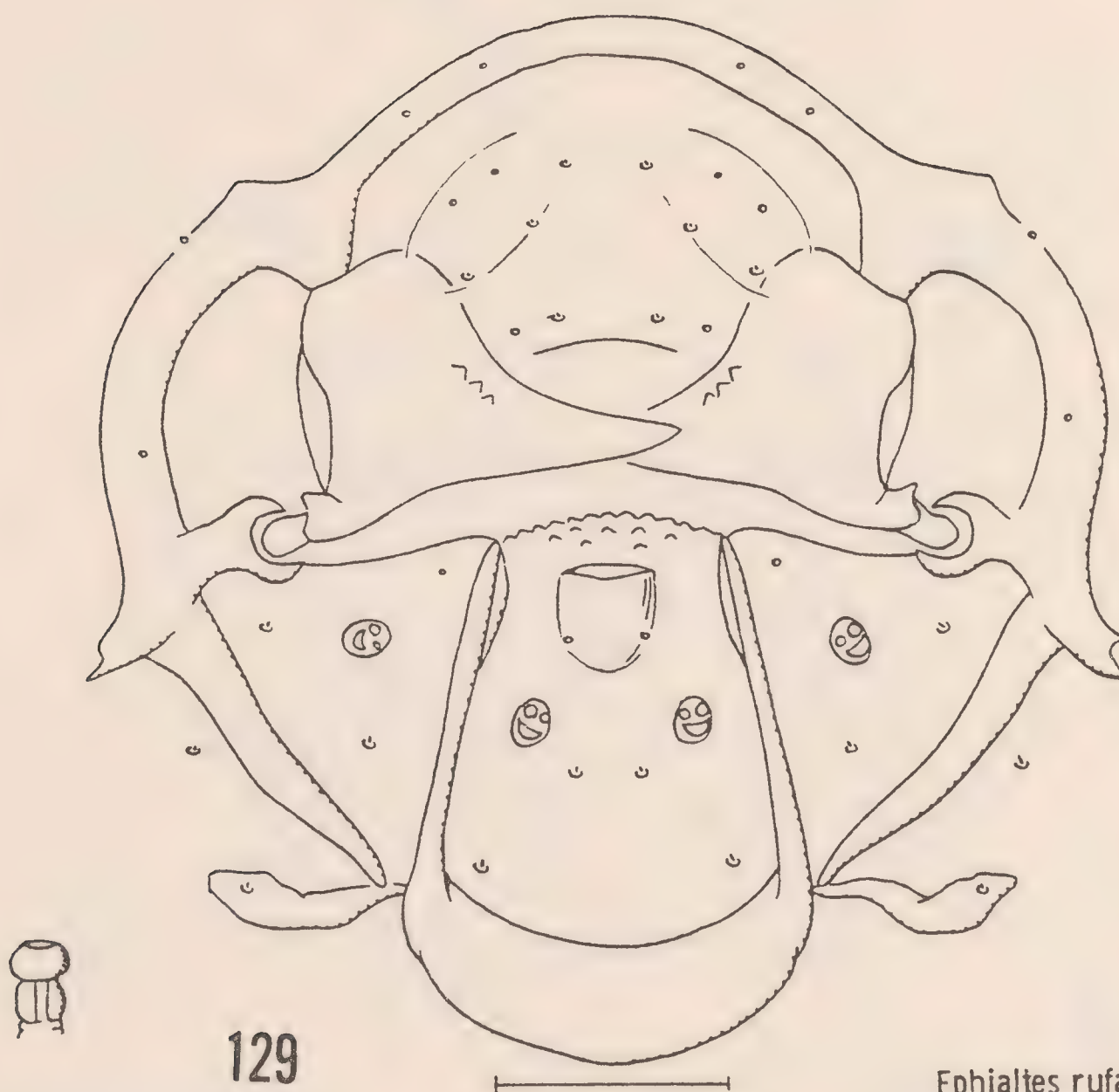
127

Itoplectis conquisitor

Figs. 126-127. Head sclerites of larvae.



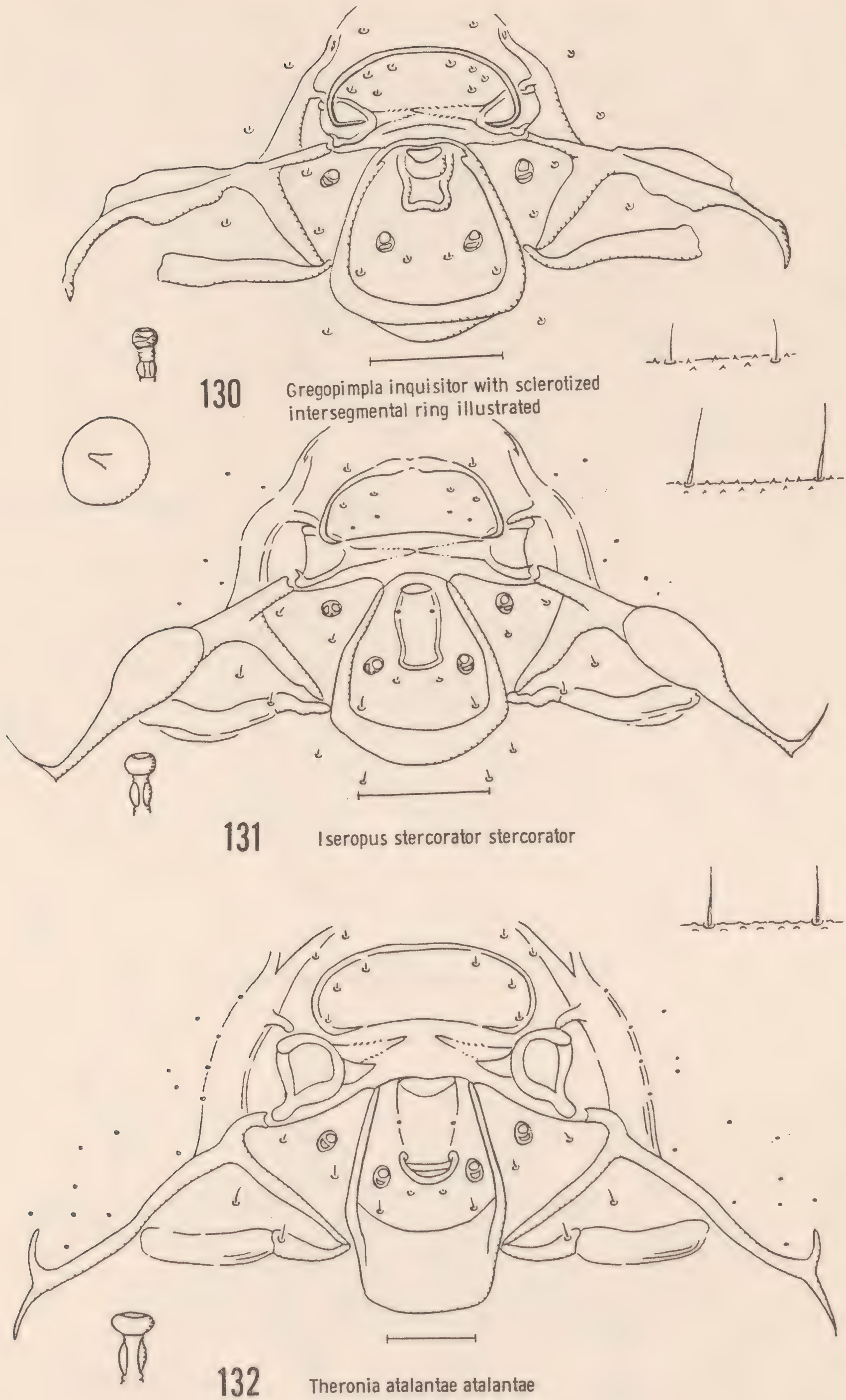
128

Ephialtes compunctor

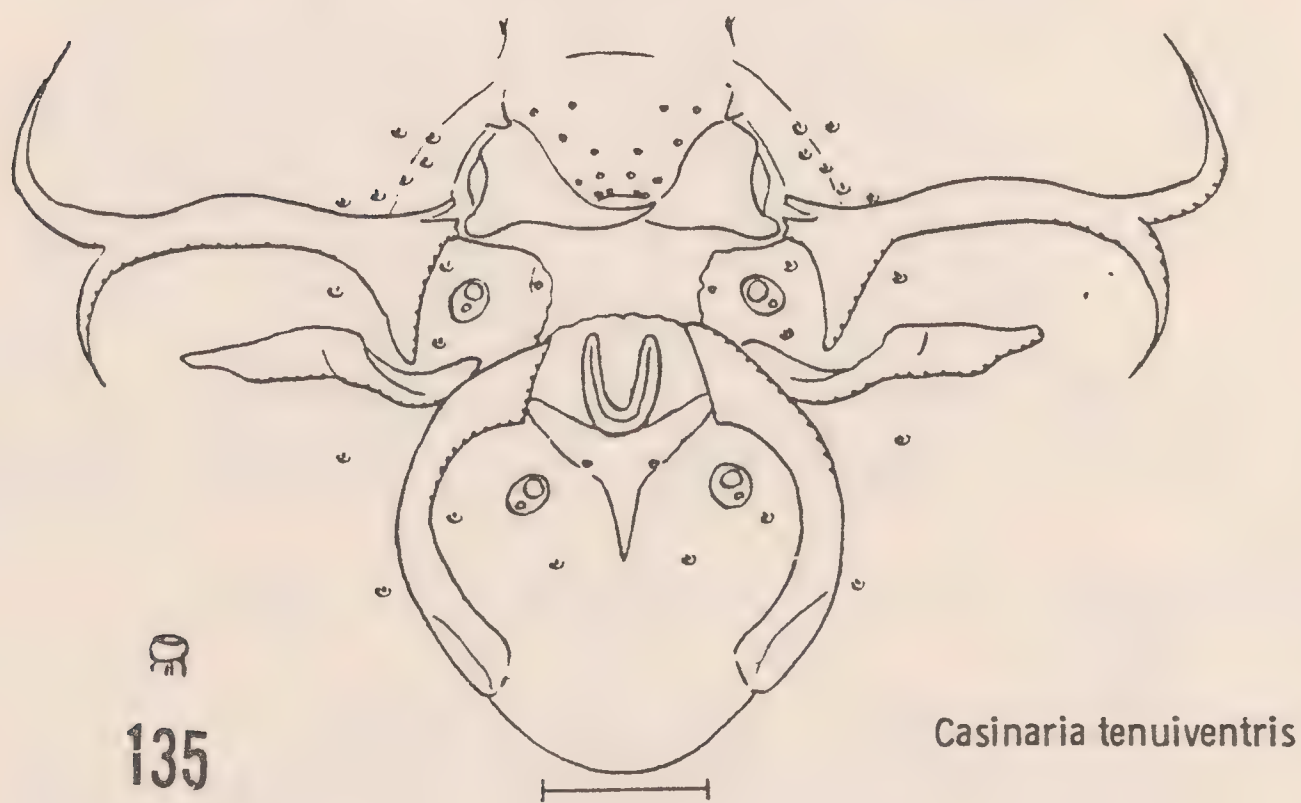
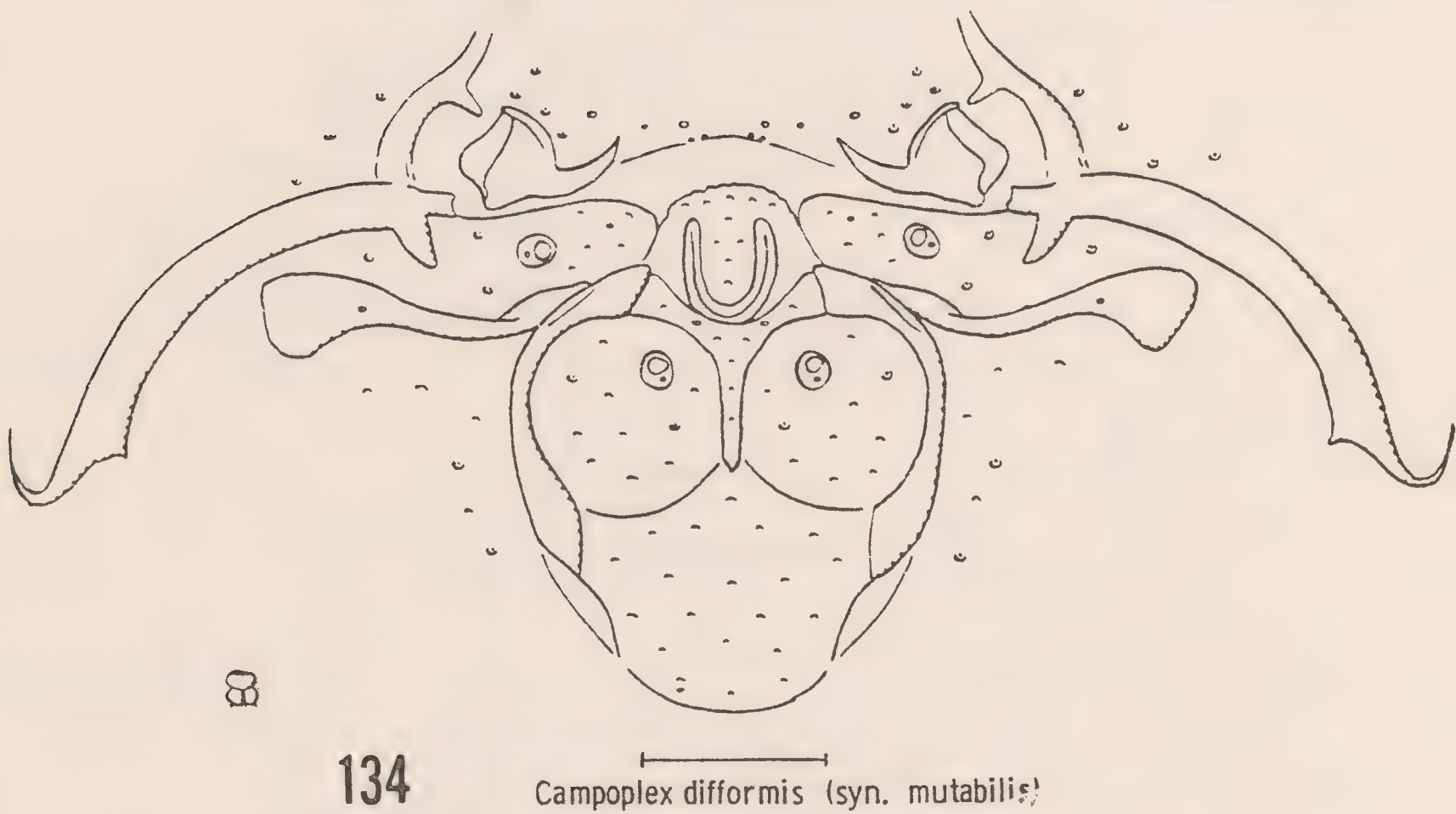
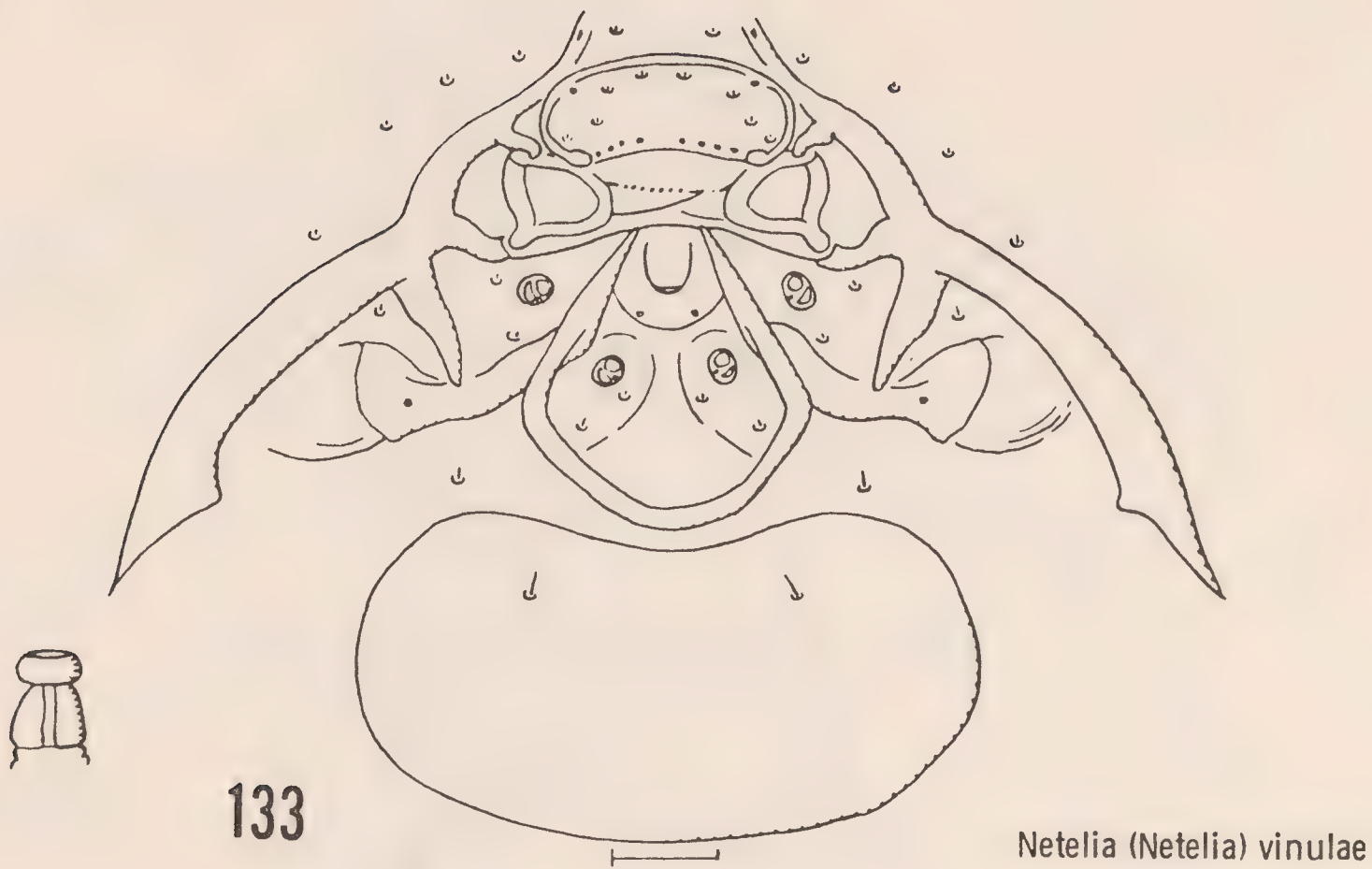
129

Ephialtes rufatus

Figs. 128-129. Head sclerites of larvae.



Figs. 130-132. Head sclerites of larvae.



Figs. 133-135. Head sclerites of larvae.



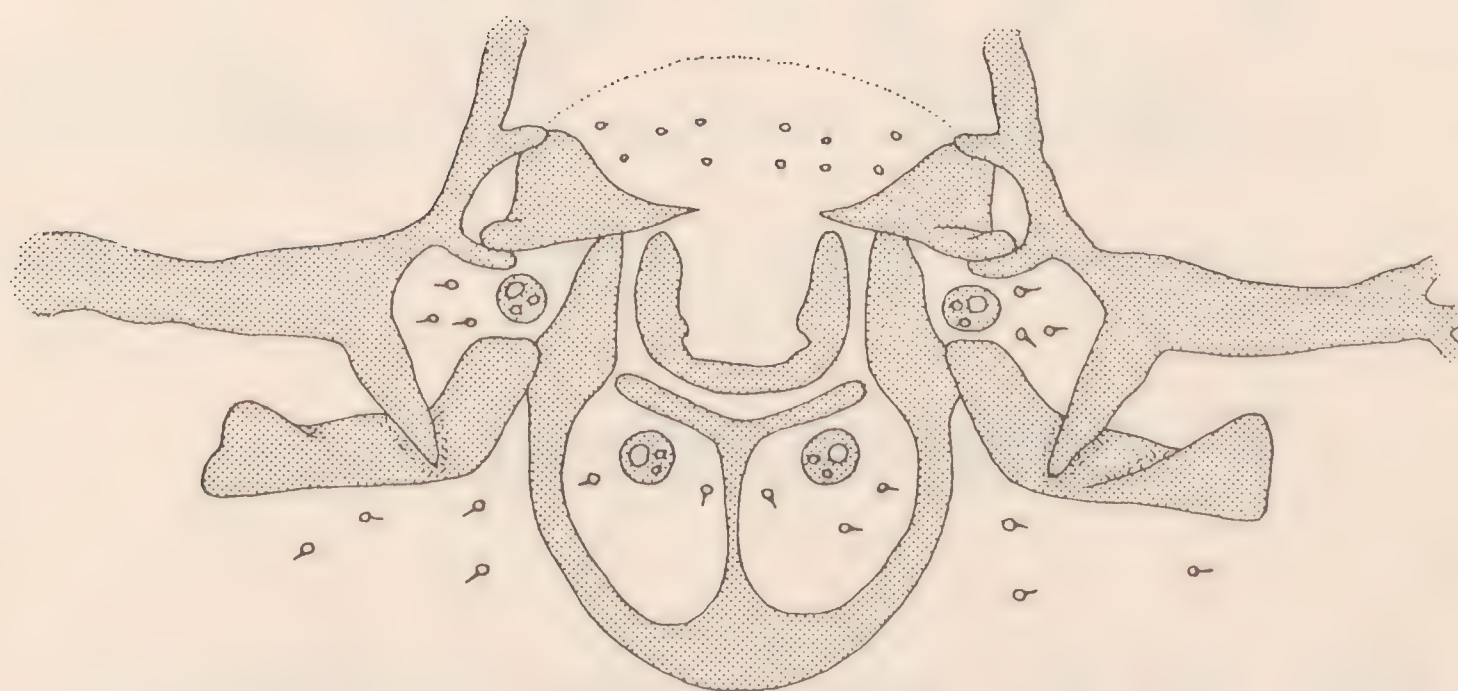
136

Phobocampe uncinata



137

Banchus hastator



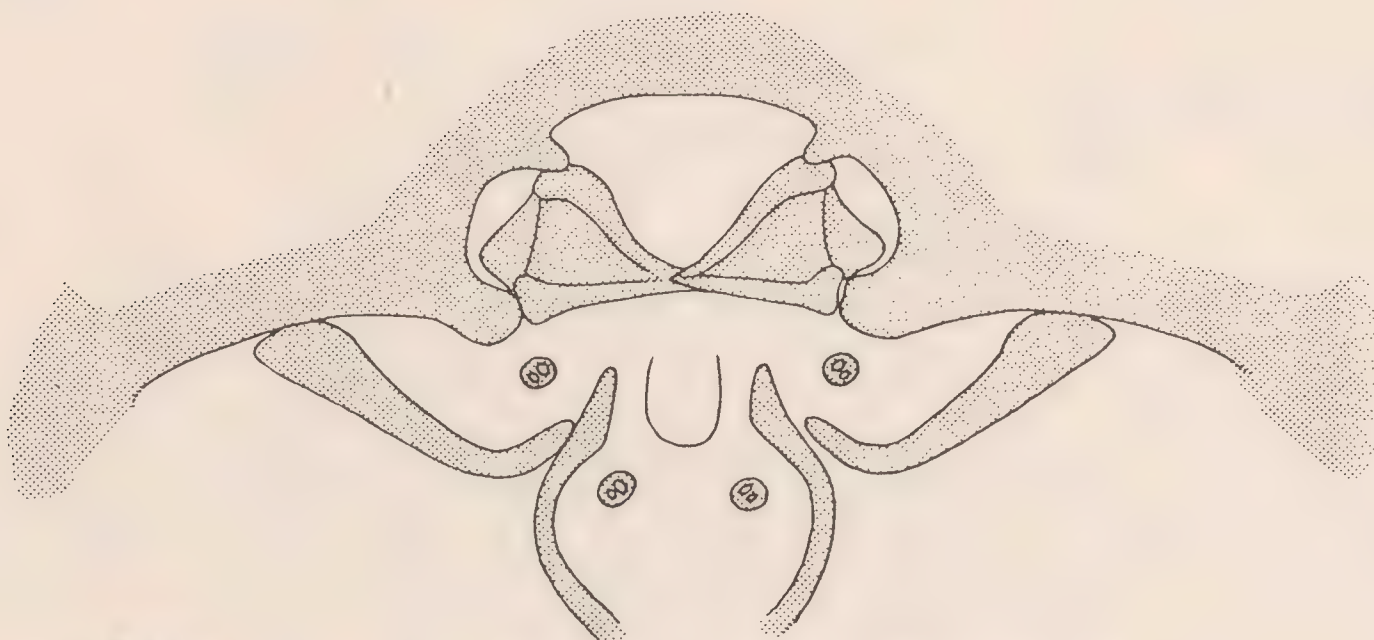
138

Banchus femoralis

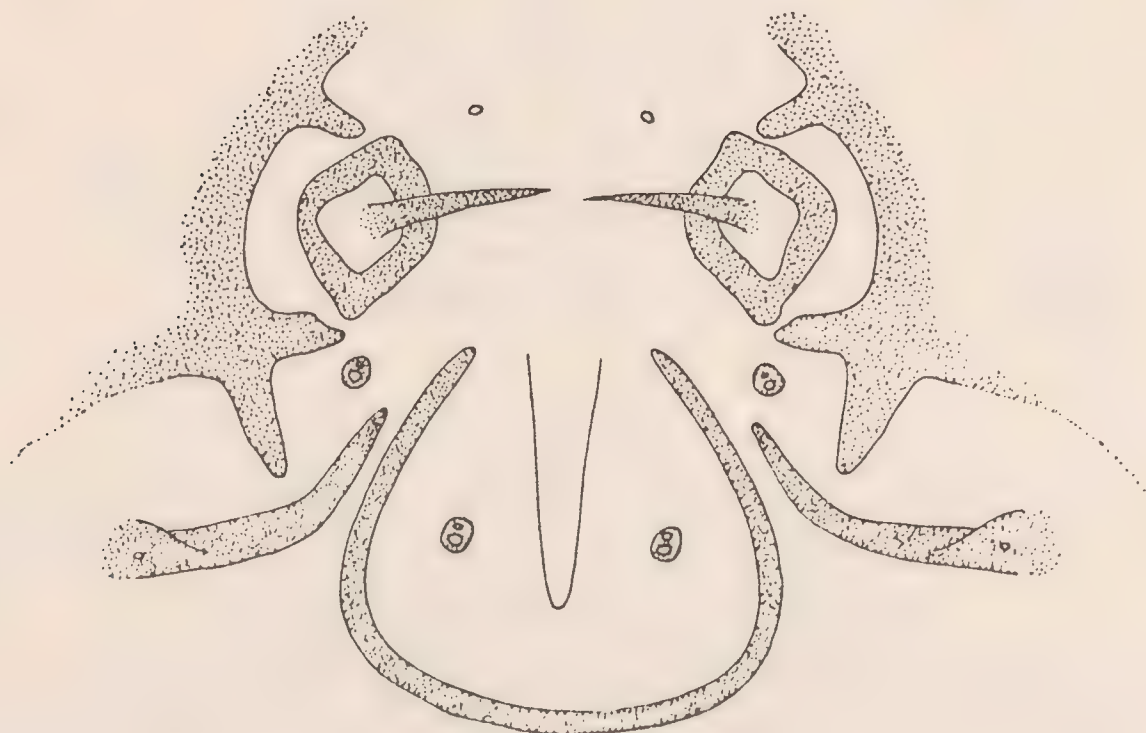
Figs. 136-138. Head sclerites of larvae.



139 Enicospilus macrurus



140 Habronyx nigricornis



141 Mesochorus fulgurans

Figs. 139-141. Head sclerites of the larvae.

Errata to: Gupta, Virendra, 1983. The Ichneumonid Parasites Associated with the Gypsy Moth (*Lymantria dispar*). Contrib. Amer. Ent. Inst. 19 (7): 1-168.

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P. 132. Under acknowledgment for illustrations add Muesbeck and Parker, 1933 for figures 59, 60 and 62.

Corrections

Page 4	Line 12 from bottom	For Lerut (1980)	Read Leraut (1980)
11	Under species 10	Add (1933) after Morley and Rait-Smith	
11	„ „ 11	For page 77	Read page 75
12	„ „ 23	For Rudow (1933)	Read Rudow (1918)
14	Line 15 from bottom	„ Nagaraja et al (1968)	Read Nagaraja et al. (1969)
104	Line 11 and 36	For Kolubayiv	Read Kolubajiv
105	Line 9	For Gupta (1973)	Read Gupta (1970)
110	Line 7 from bottom	For Kraube	Read Krausse
112	Line 5	For Delrio (1974)	Read Delrio (1975)
118	Line 3 from bottom	For Kraube	Read Krausse
124	Line 4 from bottom	For Res.	Read Rec.
127	Reference to Kovacevic	Z. should come after Kolabujiv on page 128	

Please let me know if you discover any other omission or correction.

Virendra Gupta